

DEPARTMENT OF VETERANS AFFAIRS
REHABILITATION RESEARCH AND DEVELOPMENT
NATIONAL CENTER FOR REHABILITATIVE AUDITORY RESEARCH
VA MEDICAL CENTER, PORTLAND, OREGON



ANNUAL REPORT

JANUARY 1, 2005 – DECEMBER 31, 2005

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I. BACKGROUND

Vision

Our vision is to be the national leader in rehabilitative auditory research and development, and a national resource for veterans, their families, their health care professionals, and the community at large.

Mission

The mission of the National Center for Rehabilitative Auditory Research is to benefit veterans by alleviating the economic, social and communicative problems resulting from auditory system impairments.

Background

The Veterans Affairs National Center for Rehabilitative Auditory Research (NCRAR) was established October 1, 1997 at the Portland VA Medical Center under the direction of Dr. Stephen A. Fausti. The NCRAR is one of only fifteen national ‘Centers of Excellence’ funded by the Department of Veterans Affairs (VA) Rehabilitation Research and Development (RR&D) Service. It is, however, the only center of its kind in the nation dedicated to advancing the discovery of new knowledge about hearing impairments and to developing new technologies that optimize hearing health and care for veterans and the nation.

The NCRAR is a national rehabilitation research and development program comprised of the core center at its host site, as well as a formidable network of collaborative partners at outlying VA medical centers, universities, and private-industry companies. The center’s multidisciplinary consortium of professionals work together to support and conduct rigorous research and development activities that address the auditory rehabilitation needs of veterans and the nation. The NCRAR also mentors mid- and junior-level rehabilitation researchers and engineers, disseminates evidence-based research findings and develops best practices procedures for clinicians who assess and treat veterans with auditory disabilities, and educates veterans, their families, and the public about hearing loss prevention, hearing conservation, and auditory rehabilitation devices and techniques.

Guiding Principles

- *To continue the development of shared, core center facilities and equipment resources with collaborating programs and institutions to deliver rehabilitative therapeutics in the most efficient manner;*
- *To foster and expand partnerships with community institutions, for education, dissemination of information, and training of rehabilitative auditory research-scientists and clinical professionals;*
- *To improve the quality of life of hearing-impaired veterans by providing practical solutions to fundamental problems associated with chronic impairments of the auditory system; and*
- *To utilize the research synergy of the NCRAR to develop useful innovative research and rehabilitation technologies that directly influence and contribute toward establishing standards of clinical practice.*

II. SUMMARY OF PROGRESS FOR 2005 (JAN 1, 2005 – DEC 31, 2005)

2005 Stated Goals and Objectives

Consistent with the NCRAR's *Vision, Mission, Guiding Principles*, and five-year strategic plan, the center focused on: 1) improving the lives of hearing-impaired veterans and their families by advancing the discovery of new knowledge and technologies that optimize auditory rehabilitation, developing and rigorously evaluating useful innovations in the laboratory, and applying rehabilitation research solutions to clinical practice; 2) educating and influencing the rehabilitation community by disseminating evidence-based research findings and developing best practice procedures; 3) broadening its base of consenting research participants for clinical trials of new devices, techniques, programs, and outcomes measures; 4) expanding core, shared equipment and facilities resources, and support services; 5) cultivating and encouraging innovation and synergy of intellectual resources among multidisciplinary clinicians, public health specialists, research investigators, rehabilitation engineers, educators and administrators; and 6) supporting core researchers and key collaborators whose programs and projects are in turn, supported from a variety of federal, public and private sources to effectively leverage the center's core funding. Specific 2005 goals and objectives included:

- Host our second biennial international conference in the Fall 2005 on the topic of aging and the auditory system, obtain approval as an ASHA and AAA CEU provider, and publish the conference session proceedings in a special issue of *Seminars in Hearing*.
- Produce and distribute DVDs and videos of its second biennial international conference sessions.
- Host a pre-conference workshop on ototoxicity early identification in Portland, OR immediately preceding the NCRAR's Fall 2005 conference.
- Arrange to have Clinical Research Presentations filmed and aired nationwide via the VA Employee Education System satellite network.
- Build capacity through recruitment and mentoring of pre- and post-doctoral fellows, mid- and junior-level clinical researchers, scholars and rehabilitation engineers who are deemed appropriate candidates for Associate Investigator, Research Career Development, Research Career Scientist, and other VA and non-VA research career development program opportunities.
- Support the building of research capacity through the design and construction of additional, dedicated contiguous space.
- Diversify and expand its research funding portfolio, particularly from extramural funding agencies.
- Seek approval of funding for the following rehabilitative research and development programs and projects:
 - "A Biological Interface for Cochlear Implants in Auditory Rehabilitation"
 - "A Pilot Study Using Oral N-Acetyl-L-Cysteine to Reduce Noise-Induced Threshold Shifts Associated with Combat Training"
 - "Aging, Cognition and Rapid Speech Processing: An Evoked Potential Study"
 - "Auditory Aging: Neural Synchrony in the Brainstem"
 - "Clinical Applications for Time-Compressed Speech Tests"

- “Development of Clinical Instrumentation for Tinnitus Measurement”
- “DoD/VA Joint Incentive Fund Sharing Initiative – Hearing Care”
- “Elucidation of Factors Associated with Use and Disuse of Assistive Devices”
- “Epidemiology of Speech Understanding Deficits in Diabetic Veterans”
- “Individualized Objective Measures for Early Detection of Ototoxicity”
- “Longitudinal Effects of Sensory and Cognitive Aging on Health”
- “Multi-Site Randomized Clinical Study of Tinnitus Treatment Methods”
- “Otitis Media Impact on the Inner Ear”
- “Randomized Trial of a Brief Patient-Centered Aural Rehabilitation Model”
- “The Effects of Hearing Loss on Psychological Assessment”
- “The Impact of Hearing Aid Directional Microphones on Sound Localization”
- “The Performance Perceptual Test (PPT) as a Counseling Tool”
- “The Veterans Hearing Loss Prevention Program: Improving Hearing Health”
- “Tinnitus Relief Using Variable Acoustic Stimuli”
- “Treatment for Rhinosinusitis and Olfactory Inflammation”
- “Viral Induced Sensorineural Hearing Loss: A New Treatment Strategy”
- Translate evidence-based rehabilitation research protocols for early identification and monitoring of ototoxicity into practice in the VA health care system and the nation.
- Translate second generation tinnitus quantification system into practice in other VA medical centers.
- Interface with VA RR&D Technology Transfer Program to facilitate partnering with appropriate private industry organizations to pursue having innovative technologies manufactured and distributed for use at other VAMCs and non-VA clinics.
- Develop hearing loss prevention and hearing conservation programs that can become part of the rehabilitation strategy within the VA and DoD health care systems, and the nation.
- Fulfill and expand research collaborations/clinical trials with:
 - Department of Defense (DoD), Madigan Army Medical Center, Tacoma, WA
 - DoD, Spatial Orientation Center, Naval Medical Center, San Diego, CA
 - DoD, Walter Reed Army Medical Center, Washington, DC
 - Duke University, Division of Speech Pathology & Audiology, Durham, NC
 - House Ear Institute, Los Angeles, CA
 - HSR&D Nursing Research Program, Iowa City VAMC, Iowa City, IA
 - Oregon Health & Science University (OHSU), Oregon Graduate Institute, School of Science & Engineering, Departments of Biomedical Engineering and Computer Science & Engineering, Portland, OR
 - Sound Pharmaceuticals, Inc., Seattle, WA
 - Southern Illinois University, School of Medicine, Department of Surgery, Division of Otolaryngology, Springfield, IL

- University of Western Ontario, School of Occupational Therapy, Section of Rehabilitation, Technology and Research, London, Ontario, Canada
- VA NCHSCS and East Bay Institute for Research and Education, Martinez, CA

2005 Goals and Objectives Achieved

The NCRAR met and exceeded nearly all its 2005 goals and objectives while building VA research capacity through the recruitment, retention, support and mentoring of the next generation of VA rehabilitation researchers, rehabilitation engineers, and scholars. Paramount to the NCRAR's success in achieving its goals and building VA research capacity has been our ability to accommodate additional staff and associated research and development activities through the construction of dedicated VA Center of Excellence facilities and the provision of core, shared equipment and support services. Consistent with the aforementioned stated goals and objectives, the following are several of the NCRAR's most notable achievements:

- Hosted our second biennial international conference entitled, "The Aging Auditory System: Considerations for Rehabilitation" on September 22-23, 2005, which was attended by over 200 individuals from 32 states plus New Zealand, Israel, and Canada. The conference was held at the Portland World Trade Center and the Portland Waterfront Marriott Hotel and opened with a proclamation from Portland Mayor Tom Potter declaring September 22-23, 2005 '*Rehabilitative Auditory Research Days*' in Portland. Margaret Giannini, MD, Director, Office on Disability, US Department of Health and Human Services (HHS), presented opening remarks.
- Obtained approval to offer CEUs for continuing education activities associated with the NCRAR's biennial international conference (1.4) and pre-conference workshop (0.6), from both the American Speech-Language-Hearing Association (ASHA) and the American Academy of Audiology (AAA). Additionally, the conference sessions were recorded and produced on DVD and video, and we are currently amidst the process of preparing papers of the conference proceedings for publication in a forthcoming, special issue of *Seminars in Hearing*.
- Conference proceedings from the NCRAR's 2003 biennial international conference entitled, "Aural Rehabilitation: A Multidisciplinary Approach" were published in two separate, special issues of *Seminars in Hearing* (2005;26(2):57-124; and 2005;26(3):125-189). Drs. Gabrielle Saunders and Stephen Fausti served as special guest editors, and both issues were devoted solely to publishing proceedings from the NCRAR conference.
- Recorded and disseminated our 2005 biennial international conference sessions on DVD and video.
- Hosted a national workshop entitled, "Ototoxicity: Early Identification and Monitoring" on September 21, 2005, which was attended by 50 clinical audiologists from across the country.
- Contributed significantly to the production of a special issue of the *Journal of Rehabilitation Research & Development* (2005;42:4:vii-198) focused entirely on hearing and hearing loss, with Drs. Harry Levitt, Stephen Fausti, and Jerome Schein serving as guest editors and NCRAR investigators contributing four manuscripts.

- Had a Clinical Research Presentation, “Measuring Hearing Aid Outcomes: Not as Easy as it Seems” filmed and aired nationwide via the VA Satellite Broadcast on September 8, 2005.
- Received preliminary approval to serve as the appropriate U.S. Government Agency repository for receiving, protecting, utilizing and releasing data contained in the DoD’s Defense Occupational Environmental Hearing Readiness System Hearing Conservation (DOEHRS-HC) data base. Additionally, Dr. Fausti was selected to serve as a member of the Department of Defense (DoD) Hearing Conservation Working Group (DoD HCWG).
- Dr. Leek was evaluated and approved for both a RR&D Senior Research Career Scientist Award and a Centralized Position.
- Dr. Lewis was evaluated and approved for a RR&D Research Career Development Award.
- Dr. Saunders was named President-Elect of the Academy of Rehabilitative Audiology.
- Phase-4, the final phase of construction (approximately 11,000 gross square feet) of the NCRAR’s dedicated 21,000 square foot Center of Excellence facility, was initiated as a result of approval of the center’s \$1.73M Minor Program project, with completion planned for March 17, 2006.
- Disseminated evidence-based research findings to professionals through 75 papers (i.e., published, in press, under review, and in preparation) in scientifically peer-reviewed journals and books, 45 presentations at regional, national and international scientific conferences, meetings and symposia.
- Disseminated VA RR&D NCRAR research achievements to a broad spectrum of professional and lay audiences as a result of hosting an international conference; a national workshop; twenty-one clinical research presentations, roundtables and workshops; twelve community hearing health fairs; and the NCRAR’s worldwide website (www.ncrar.org).
- Submitted a Disclosure of Invention for its “Computer Automated Tinnitus Psychoacoustic Testing System”, which was built from the platform of the Programmable Audio Laboratory (PAL3000), which the VA has already asserted ownership rights.
- Diversified and expanded its funding portfolio, particularly from extramural funding agencies.
- Recruited, mentored and supported a talented group of rehabilitation research-scientists, including the following career development awardees and applicants:
 - Senior Research Career Scientist Awardee, Marjorie Leek, PhD
 - Research Career Development Awardee, M. Samantha Lewis, PhD
 - Advanced Research Career Development Applicant, Dawn Konrad-Martin, PhD
 - Associate Investigator Applicant, Michelle Molis, PhD
- Receiving approval of funding for the following lines of rehabilitation research and development:
 - “A Biological Interface for Cochlear Implants in Auditory Rehabilitation”
 - “Auditory Modeling of Suprathreshold Distortion in Persons with Impaired Hearing”

- “Evaluation of a Brief Group Aural Rehabilitation Treatment”
- “Hearing Rehabilitation from the Perspective of the Significant Other”
- “Individualized Objective Measures for Early Detection of Ototoxicity”
- “Otitis Media Impact on the Inner Ear”
- “Randomized Trial of a Brief Patient-Centered Aural Rehabilitation Model”
- “Senior Research Career Scientist Award for Marjorie Leek, PhD”
- “Steroid Responsive Mechanisms in the Ear”
- “The Impact of Hearing Aid Directional Microphones on Sound Localization”
- “The Performance Perceptual Test (PPT) as a Counseling Tool”
- “Viral Induced Sensorineural Hearing Loss: A New Treatment Strategy”
- Expanded research collaborations/clinical trials with:
 - Boys Town National Research Hospital, Omaha, NE
 - Center for Aging with Low Vision (CAVL), RR&D Center of Excellence in Atlanta/Decatur, GA
 - HSR&D Multiple Sclerosis Center of Excellence – West, Portland, OR
 - RR&D Program, VAMC Bay Pines, Bay Pines, FL
 - RR&D Program, VAMC San Diego, San Diego, CA
 - RR&D Program, VA Puget Sound Health Care System (VAMCs at Seattle and Tacoma, WA)
- Initiated new research collaborations/clinical trials with:
 - DoD, Madigan Army Medical Center, Tacoma, WA
 - DoD, Walter Reed Army Hospital, Washington, DC
 - Kresge Hearing Research Institute, Department of Otolaryngology, University of Michigan Medical School, Ann Arbor, MI
 - Oregon Graduate Institute School of Science & Engineering, OHSU, Portland, OR
 - Polytrauma and Blast-Related Injuries Quality Enhancement Research Initiative (QUERI), Rehabilitation Centers (Minneapolis, MN, and Palo Alto, CA)
 - University of California, San Diego, School of Medicine, Division of Otolaryngology, Department of Surgery, Research Section, San Diego, CA

Future Goals and Objectives

The NCRAR will continue to use its highly successful model of providing dedicated facilities, shared equipment and core personnel resources, and start-up needs for junior rehabilitation researchers to shape its future. Additionally, the NCRAR will continue to encourage and support the synergistic effect of multidisciplinary intellectual resources from core clinicians, rehabilitation researchers, educators, rehabilitation engineers and key collaborators whose programs and projects are in turn supported through a variety of federal, public and private funding sources to effectively leverage the Center’s core funding. Specific future goals and objectives include:

- Host a third biennial international conference in Portland, OR during the Fall 2007, and subsequently produce and distribute the conference sessions on DVD and video. Dr. Gabrielle Saunders and Ms. Carolyn Landsverk are co-chairing the conference entitled, 'Hearing Loss: Techniques and Technology for Prevention'. The conference will be held on September 27-28, 2007 at the World Trade Center in downtown Portland, OR. The program committee is being chaired by Dr. Dawn Konrad-Martin.
- Record and broadcast additional Clinical Research Presentations using the VA Employee Education System satellite network and V-Tel system.
- Continue to build capacity through recruitment and mentoring of pre- and post-doctoral fellows, mid- and junior-level clinical research-scientists, scholars and rehabilitation engineers who are deemed appropriate candidates for Associate Investigator, Research Career Development, Research Career Scientist, and other VA and non-VA research career development program opportunities.
- Become involved in training programs for the next generation of clinical researchers in audiology.
- Initiate a research program in vestibular/balance disorders.
- Seek to further diversify and expand its research and development funding portfolio.
- Seek approval of funding for the following lines of rehabilitative research and development:
 - "A Test to Measure the Impacts of Dual-Sensory Impairment on Daily Function"
 - "Central Auditory Processing Disorders Associated with Blast Exposure"
 - "Clinical Applications for Time-Compressed Speech Tests"
 - "DoD/VA Joint Incentive Fund Sharing Initiative- Hearing Loss Prevention Program"
 - "Effects of Hypertension on Hearing Loss in Type 2 Diabetic Patients"
 - "Effects of Training on Central Auditory Function in Multiple Sclerosis"
 - "Frequency Tuning and Word Recognition Speed in Older Adults"
 - "Improving Health Literacy Using a Tinnitus Education Model"
 - "Individualized Objective Measures for the Early Detection of Ototoxicity"
 - "Limiting Inflammation in Bacterial Meningitis by Targeting Host Immune Pathways"
 - "Lipoic Acid Therapy for Ototoxicity Prevention"
 - "Non-invasive Blood Glucose Monitoring by Otoacoustic Emissions (OAE)"
 - "Otitis Media Impact on the Inner"
 - "Progressive Intervention Program for Tinnitus Management"
 - "Randomized Clinical Study of Group Education for Tinnitus Intervention"
 - "Temporal Resolution of Cochlear and Auditory Nerve Responses in Older Adults"
 - "The Veterans' Hearing Loss Prevention Program: Improving Hearing Health"
- Hearing loss prevention and hearing conservation programs and practices will be developed and should become part of clinical rehabilitation strategy throughout the VA and DoD health care systems, and the nation.

- Interface with the RR&D Technology Transfer Program to facilitate partnering with appropriate private industry organizations to have innovative, clinically useful tools (e.g., AnalyzeOAE and AudioTest software applications, Computer Automated Tinnitus Psychoacoustics Testing system, Directional Microphone Test system, Method and Device for Non-invasive Analyte Measurement, OtoID device, and the PAL3000) translated into clinical practices at other VAMCs and across the nation.
- Fulfill research collaborations/clinical trials with:
 - Advanced Cochlear Systems, Snoqualmie, WA
 - DoD, U.S. Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Ground, MD
 - DoD, U.S. Army Garrison Fort Bragg, NC
 - Hearing Components, Oakdale, MN
 - NeuroTone, Inc., Redwood City, CA
 - OHSU, Oregon Graduate Institute, School of Science & Engineering, Departments of Biomedical Engineering and Computer Science & Engineering, Portland, OR
 - Polytrauma and Blast-Related Injuries Quality Enhancement Research Initiative (QUERI), Rehabilitation Centers, Minneapolis, MN and Palo Alto, CA
 - RR&D Center of Excellence on Restoration of Function in Spinal Cord Injury and Multiple Sclerosis, West Haven, CT
 - Sensimetrics Corporation, Somerville, MA
 - Southern Illinois University, School of Medicine, Division of Otolaryngology, Springfield, IL
 - The Smith-Kettlewell Eye Research Institute, San Francisco, CA
 - University of Auckland, School of Population Health, Section of Audiology, Auckland, New Zealand
 - University of California, San Francisco, School of Medicine, Division of Otolaryngology, Department of Audiology, San Francisco, CA

Plan Adjustments

The NCRAR administration has worked diligently to maintain a delicate balance between cultivating the growth and development of a community of multidisciplinary clinical scientists and scholars, and obtaining incremental allocations of additional dedicated space within which to accommodate the center's activities and staff. Approval of the center's \$1.73M Minor Program project enabled us to complete the architectural design and initiate construction of the final phase (approximately 11,000 square feet) of the NCRAR's dedicated Center of Excellence facility (nearly 21,000 square feet of contiguous space). The design and construction of this facility required routine meetings with the contracted architect, project engineer, construction contractor, and a multitude of subcontractors to coordinate the various phases of construction with installation of sound booths and an anechoic chamber. As a result, the facility is optimally suited to meet the current and future needs of cutting edge rehabilitation research and development, and will provide a unique mentoring and research synergistic advantage that will be difficult, if not impossible, to accomplish elsewhere.

III. PROJECT REPORTS

VA Submissions (n = 8; total requested funding = \$3,297,590)

Title: Effect of Training on Central Auditory Function in Multiple Sclerosis

Principal Investigators: Dennis N. Bourdette, MD; Nancy E. Vaughan, PhD

Participating Investigators: M. Samantha Lewis, PhD; Debbie J. Wilmington, PhD

Funding Agency: VA RR&D

Total Requested Funding: \$595,200

Timeframe: Three years requested (pending outcome of scientific merit review)

Objectives: Multiple sclerosis (MS) is an inflammatory disease of the central nervous system that affects approximately 26,000 veterans (MS Centers of Excellence, 2004). Although peripheral hearing loss is rare in this population, 40% to 60% of MS patients with normal pure-tone thresholds present with hearing difficulty especially in backgrounds of noise. We hypothesize, that this may be due, in part, to central auditory processing deficits caused by focal loss or destruction of myelin sheath (demyelination) in the auditory nervous system. With these thoughts in mind, the purpose of the proposed investigation is to assess thoroughly the central auditory processing (CAP) deficits for patients with MS. Additionally, since there is evidence that the brain is plastic and capable of being retrained (Jancke, Gaab, Wustenberg, et al, 2001), this investigation also will examine whether or not the implementation of an auditory training program can improve central auditory function in patients with MS.

Plan: In the current (ongoing) study, test materials were developed to evaluate auditory function in MS patients and in patients who do not have MS. For the proposed extension of this study central auditory function will be further characterized and potential rehabilitative strategies will be examined. Experimental subjects will be recruited from the Portland VAMC, Oregon Health & Science University and from the general community. Control subjects will be matched to the subjects with MS with respect to age, gender and audiometric configuration.

Methods: Five general types of evaluations will be employed over multiple study sessions. First, a neurologist will review the subject's medical history and perform a neurologic exam to confirm MS diagnosis. Second, peripheral auditory function will be evaluated using a standard set of routine audiometric tests. Additionally, subjects will complete a case history and series of hearing handicap inventories. Third, a battery of behavioral procedures will be used to characterize central auditory processing. Fourth, auditory evoked potential studies will be performed. Emphasis here will be upon evoked potentials whose putative neural generators lie within the central auditory nervous system. Fifth, subjects will receive functional MRI evaluation to determine site and amount of neural activation during dichotic listening. After evaluation, subjects will be enrolled into a home-based auditory training program to evaluate possible improvements in auditory function. After training, the aforementioned evaluation procedures will be repeated.

Findings to date: There are no findings to report at this time as this proposal is currently pending outcome of scientific merit review.

Title: Randomized Clinical Study of Group Education for Tinnitus Intervention

Principal Investigator: James A. Henry, PhD

Funding Agency: VA RR&D

Total Requested Funding: \$401,200

Timeframe: Three years requested (pending outcome of scientific merit review)

Objectives: Tinnitus is the third most common individual service-connected disability (VBA Annual Benefits report). As of September 30, 2005, over 339,573 veterans had been awarded a service connection for their tinnitus, equating to over \$418,000,000 in annual compensation benefits (Office of Policy and Planning, VA Central Office). In spite of the magnitude of the problem, most VA medical centers do not provide clinical management for veterans with problematic tinnitus. The proposed study addresses this need.

An outcome study was completed recently at the Portland VAMC to establish the benefit of providing group educational counseling for veterans who have clinically significant tinnitus. Results showed that group education provided significant improvement to these veterans. The objective of the proposed study is to further develop the group education methodology to optimize outcomes and to improve clinical expediency.

Plan: The group counseling protocol will be revised to address the most critical needs of tinnitus patients and to optimize long-term recall of the information. The four counseling sessions will be reduced to two for purposes of clinical expediency. We will test the hypothesis that extending the two sessions over time will improve long-term patient recall of the counseling information.

Methods: Veterans who respond to recruitment ads will be screened by telephone to ensure that their tinnitus is clinically relevant. A total of 270 veterans will be enrolled. Qualifying veterans will be randomized into three groups: Concentrated Educational Counseling (CEC), Extended Educational Counseling (EEC), and "Usual Care." Subjects in the two Education groups will attend two 2-hour sessions of educational counseling. The two sessions will be separated by 1 week for the CEC group, and by 3 months for the EEC group. These subjects will complete outcome questionnaires at baseline, and at 6, 12, and 24 months post-baseline. Subjects in the Usual Care group will not attend any sessions but will complete outcome questionnaires at baseline, and at 6 and 12 months post-baseline. Usual Care subjects will be given the opportunity to receive the group education after 12 months.

Findings to date: There are no findings to report as this proposal is pending outcome of scientific merit review. In the previous study 310 veterans were enrolled. Results of completed questionnaires revealed significant improvement on all outcome measures for the Education Group. The Support Group showed minimal improvement on only a few of the measures, while the Usual Care group showed no improvement. These results suggest that group educational counseling can be effective for the majority of veterans who require tinnitus services.

Title: Progressive Intervention Program for Tinnitus Management

Principal Investigator: James A. Henry, PhD

Funding Agency: VA RR&D

Total Requested Funding: \$383,800

Timeframe: Three years requested (pending outcome of scientific merit review)

Objectives: The 2004 VA Annual Benefits Report indicates that tinnitus is the third most common individual service-connected disability. As of September 30, 2005, there were 339,573 veterans who had been awarded a service connection for their tinnitus, with annual compensation amounting to over \$418,000,000 (Office of Policy and Planning, VA Central Office). In addition to being a major expense for VHA, tinnitus is a health care problem that is inadequately addressed at most VA medical centers. Research at the NCRAR has resulted in a model of tinnitus clinical management that is designed for efficient implementation in VA audiology clinics. The objective of the proposed study is to establish the model program at a VA audiology clinic, and to evaluate its efficacy with veteran patients and its acceptability to audiologists and to hospital administration.

Plan: The proposed study will be based at the NCRAR, and a prototype tinnitus management program will be established at the James A. Haley Tampa VA Medical Center. Audiologists at the Tampa VAMC will be trained to conduct all phases of progressive intervention for tinnitus. Following training, the program will be implemented with veteran patients. Evaluation of the program's efficacy will involve outcome measures with the veteran patients, and assessment by audiologists and hospital administration.

Methods: During the first year of the study, a comprehensive web-based tinnitus training program for audiologists will be developed. Following development, audiologists at the Tampa VAMC will complete the training program as preparation to conduct each of five levels of intervention: screening, group educational counseling, tinnitus intake assessment, ongoing treatment, and extended treatment. In addition, a patient tinnitus-information booklet will be developed, using principles of low health literacy. The management program will be ready for clinical implementation by the end of the first year. During years 2 and 3, veteran patients who complain of tinnitus will be invited to participate in the program. Outcomes will be evaluated separately for clinicians, administrative staff, and patients. Clinicians will be surveyed to determine their level of satisfaction with the program. Administrative staff will be surveyed to determine if the program meets the needs and objectives of the medical center. Patients will be evaluated pre- and post-treatment to determine if participation in the program reduces their perceived tinnitus handicap.

Findings to date: The study is pending review. There are therefore no findings to report.

Title: Clinical Applications for Time-Compressed Speech Tests

Principal Investigator: Nancy E. Vaughan, PhD

Funding Agency: VA RR&D

Total Requested Funding: \$518,900

Timeframe: Three years requested (pending outcome of scientific merit review)

Objectives: This proposal will expand the findings of the previous study of the role of cognitive decline in speech understanding deficits of older listeners, and will begin to explore clinical applications for time-compressed speech testing. Two-thirds of older people who need them do not obtain hearing aids (JAMA, 2003). The reasons for lack of hearing aid use, poor user satisfaction and inadequate hearing aid benefit are still unclear. Age-related changes in central auditory and cognitive processing that are not addressed by hearing aids are the most likely candidates to account for a portion of these difficulties. The objectives of this proposal are: 1) to validate speech recognition performance with speeded speech as a valid measure of cognitive deficits, and 2) to evaluate hearing aid benefit using speeded speech tests as a sensitive measure of the benefits derived from various signal processing algorithms in hearing aids.

Plan: Participants aged 50 through 75 years will be tested over a three-year period with three separate test batteries: time-compressed speech recognition tests, neurocognitive tests, and hearing aid performance tests and questionnaires. Participants will be recruited from the current study that is in completion stage to insure reliability of time-compressed speech test results.

Methods: The test battery is designed to expand on the current findings that time-compressed speech test results provide information about cognitive processing that is relevant to age-related speech understanding deficits. Additional cognitive measures such as the classic reading span test of working memory and a short cognitive consonant-vowel-consonant test will be included based on current findings and on new literature. Hearing aid testing will determine whether the time-compressed speech test developed at the NCRAR can be used to predict individual listeners' sensitivity to temporal distortions introduced into amplified speech by signal processing algorithms.

Findings to date: There are no findings to report at this time as proposal is currently under scientific peer review. In the current study of cognition and speech perception in older listeners (#C2631R) it has been shown that the time compressed speech test is importantly related to two types of working memory. The new proposal will expand these results to clinical applications that will identify middle-aged and older individuals whose working memory deficits may affect their ability to understand processed speech that has temporal distortions due to fast amplitude compression time constants. Specifically, whether the selection of appropriate hearing aid signal processing can be based on individual time-compressed speech performance. These results will lead to new auditory training strategies and to development of new technologies for hearing aid users.

Title: Frequency Tuning and Word Recognition Speed in Older Adults

Principal Investigator: Dawn L. Konrad-Martin, PhD

Funding Agency: VA RR&D

Total Requested Funding: \$390,000

Timeframe: Three years requested (pending outcome of merit review; 07/01/06 – 06/30/09)

Objectives: The goal of this Advanced Research Career Development (ARCD) proposal is to provide mentored training to facilitate the professional growth of this new investigator, ultimately resulting in her securing independent research funding.

Plan: This ARCD award will assist Dr. Konrad-Martin in developing a program of research aimed at teasing apart the various levels of underlying physiology that contribute to impaired speech comprehension by the elderly. The hypothesis to be tested is that distortions of the speech input signal due to abnormal frequency tuning combined with slowed perceptual encoding contributes to abnormal comprehension of speech by older people with hearing loss. The well-known age-related deficit in speech understanding ability is a significant and increasingly prevalent problem in our society. Veterans are at increased risk for such difficulties as they age because many veterans have hearing loss related to exposure to excess levels of noise. Results of this research may contribute to remediation strategies, possibly through the development of hearing aid processing schemes or therapeutic interventions, which will address the communication difficulties of individual hearing-impaired veterans.

Methods: Proposed experiments will assess listener's performance on a time-gated word recognition task, in which word recognition is evaluated as a function of the portion of the word presented. Specifically, this study will determine (1) the extent that physiological estimates of frequency tuning based on response delays of tone-burst-evoked otoacoustic emissions predict psychophysical tuning measures in young and elderly subjects with normal and impaired hearing; and (2) the extent that age and actual or simulated losses in sensitivity and frequency tuning alters the accuracy, speed and confidence with which listener's are able to identify time-gated words.

Findings to date: This proposal is currently under review. Thus, there are no findings yet to report.

Title: Effects of Hearing Loss on Neuropsychological Assessment

Principal Investigators: Daniel M. Storzbach PhD; Nancy E. Vaughan PhD

Funding Agency: VA RR&D

Total Requested Funding: \$296,250

Timeframe: Three years requested (reviewed – not funded)

Objectives: This study proposed to rigorously investigate the effects of hearing loss on neuropsychological test performance and systematically evaluate whether neuropsychological test performance of patients with hearing loss is significantly improved by the use of an assistive listening device. It was supported by the well-reasoned clinical need for audiologic assessments to identify hearing loss in patients receiving neuropsychological assessments, for assessing whether the use of an assistive listening device during neuropsychological testing is effective tool for reducing the adverse effects of hearing impairment on neuropsychological test results, and to provide valid and reliable quantification of the relationships between hearing loss and performance on specific neuropsychological tests necessary for appropriate clinical interpretation. We expected the study would provide information to improve the reliability and sensitivity of neuropsychological assessments, resulting in more accurate diagnoses, improved treatment, and the development of more appropriately targeted rehabilitation strategies. Changes in clinical practice resulting from demonstration of the need for systematic audiometric screening and appropriate correction for hearing loss for veterans receiving neuropsychological assessment could significantly improve health services, reduce DVA costs, and improve the quality of life for veterans who may not otherwise have their neuropsychological decline and/or hearing loss appropriately diagnosed or rehabilitated.

Plan: Men and women 45 to 75 years of age were to have been recruited, assessed for hearing loss, and administered two neuropsychological assessments.

Methods: Based on hearing assessment consisting of pure-tone threshold testing during the first session, participants were to be divided into three groups according to level of hearing loss: a normal hearing control group, a mild to moderate hearing loss group, and a moderately severe hearing loss group. Participants were to be tested in two separate test sessions. During test sessions a battery of neuropsychological tests were to be administered to participants. During the first session, participants were to have undergone audiometric testing and to have received the first administration of the neuropsychological assessment battery. The purpose of the second session was to evaluate the effects of the assistive listening device on the neuropsychological test results. During the second session, participants with hearing loss were to receive a second administration of the same or equivalent (alternative forms) neuropsychological tests while using a wireless FM system, an assistive listening device that can be adjusted consistent with each individual's hearing loss characteristics.

Findings to date: There are no findings to report as this project was not funded.

Title: Cognitive Behavioral Therapy to Reduce Distress of Chronic Tinnitus

Principal Investigator: Daniel M. Storzbach, PhD

Funding Agency: VA RR&D

Total Requested Funding: \$463,340

Timeline: Three years requested (reviewed – not funded)

Objectives: Subjective tinnitus is the sensation of hearing a sound without external auditory stimulation. Symptomatic of auditory system pathology, chronic sensorineural tinnitus is experienced by millions of Americans. Direct effects of problematic chronic tinnitus include emotional, cognitive, and sleep disorders, all of which can adversely affect everyday activities of daily living (Axelsson, 1998; Erlandsson et al., 1992; Tyler, 1993). Due to the fact that some of the worst effects of tinnitus are psychological, various psychological interventions have been used for purposes of providing relief from tinnitus. In the 1980s, there was a paradigm shift in psychological researchers approach to tinnitus treatment, in part based upon recognition that tinnitus shares many psychological features with chronic pain (Møller, 1987), and that numerous studies have demonstrated the efficacy of cognitive-behavioral therapy for management of chronic pain. Cognitive Behavioral Therapy (CBT) is a psychological intervention that identifies negative behaviors, beliefs, and reactions and assists the patient in substituting appropriate and positive reactions (Sweetow, 2000).

Plan: The proposed Advanced Research Career Development (ARCD) study for Dr. Storzbach seeks to confirm the efficacy of a manualized 8-week group CBT therapy protocol for tinnitus treatment, and to evaluate its outcome at 12 months. The experience gained in implementing this ARCD study is intended to lay the foundation for future larger-scale randomized trial comparisons of CBT with other tinnitus interventions such as TRT and Tinnitus Masking. Implementation of this study would establish the resources and trained personnel for future studies comparing CBT to other tinnitus treatments.

Methods: Veterans with clinically significant tinnitus will be recruited to participate in the proposed randomized clinical trial at the Portland VAMC. Eligible veterans will be randomly enrolled into one of three study arms: (1) Cognitive Behavioral Therapy (CBT); (2) Educational Counseling (EC); and (3) Usual Care (UC; waiting-list controls). Intervention sessions will be led by D. Storzbach (CBT) and J. Henry (EC). UC participants will not receive any study intervention. CBT will be conducted as a series of eight sessions spaced 1 week apart (Henry & Wilson, 2001). EC will involve the same eight sessions, but the content will be limited to educational counseling based on principles of Tinnitus Retraining Therapy (TRT) (Jastreboff & Hazell, 2004). Study candidates will undergo audiometric testing and will complete baseline questionnaires to assess eligibility, and to provide demographic and outcome-variable information.

Participants will complete outcome questionnaires four times during the 12-month study period. The experimental design is a prospective, parallel, randomized clinical trial. The three study arms are (1) Cognitive Behavioral Therapy (CBT); (2) Educational Counseling (EC); and (3) Usual Care (UC). Veterans assigned to Usual Care will not receive any intervention associated with the study. Participants in CBT and EC will attend eight weekly sessions. Participants in all three groups will complete questionnaires at baseline, and at 3, 6, and 12 months. After the 12-month survey data collection is complete, UC participants will be given the opportunity to receive their choice of either CBT or EC, but without further outcomes assessment.

Findings to date: There are no results to report as this proposal did not receive a fundable score.

Title: A Test to Measure the Impacts of Dual-Sensory Impairment on Daily Function

Principal Investigator: Gabrielle H. Saunders, PhD

Co-Principal Investigators: Nancy E. Vaughan, PhD; Katharina V. Echt, PhD

Funding Agency: VA RR&D

Total Requested Funding: \$248,900

Timeframe: Two years requested (under review – pending outcome scientific merit review)

Objectives: Combined hearing and vision loss is common among older Americans however, little is known about the functional impacts of dual sensory impairments (DSI). Similarly, there is currently no tool available for quantifying the impact DSI has upon daily function and communication. In this study we will: a) document the difficulties encountered in daily living by individuals with dual sensory impairment (DSI); and then b) use this information to develop a measure to quantify the effects of DSI upon activities of daily living. This measure will be based upon other tools that already exist, but will be modified to ensure that all tasks in the new measure require use of both hearing and vision for optimal performance.

Plan: The lead site for this study is the National Center for Rehabilitative Auditory Research (NCRAR) in Portland, Oregon. The secondary site is the Center for Aging with Vision Loss (CAVL) in Atlanta Georgia. The study will take place in three phases. In Phase I, we will elucidate the difficulties encountered by individuals with DSI via focus group discussions. In Phase II, we will use the information gained in Phase I to develop the measure of DSI. During Phase III pilot testing of the new measure will undergo pilot testing. Due to the short duration of this funding, only preliminary pilot testing will be accomplished.

Methods: In Phase I, subjects will attend just one research visit at which they will participate in a focus group along with other individuals. The goal of the focus groups will be to determine functional difficulties encountered by individuals with both hearing and visual impairment, which are difficulties these individuals encounter during instrumental activities of daily life, such as shopping, communicating and way-finding. In Phase II the DSI test will be developed and a formative evaluation will be conducted. Data obtained from the focus groups conducted during Phase I will be used to determine the main content areas of the test measure, while established methodology and tests will be modified to include these content areas. Once an initial version of the test has been developed, the formative evaluation will be conducted. In Phase III pilot testing of the DSI measure will be conducted. As in Phase II, subjects will attend one research visit at which they will undergo audiological testing, visual testing, complete questionnaires assessing auditory and visual disability and handicap and they will complete the new DSI measure. Analyses to determine the relationship of the DSI measure to reported and measured impairment, disability and handicap will be conducted.

Findings to date: The study is currently under review and pending outcome of scientific merit review; therefore there are no findings to report at this time.

VA Approvals (n = 8; total funding received = \$4,368,910)

Title: Hearing Rehabilitation from the Perspective of the Significant Other

Principal Investigator: M. Samantha Lewis, PhD

Funding Agency: VA RR&D

Total Funding Received: \$336,900

Timeframe: 07/01/05 – 06/30/08

Objectives: The presence of a hearing impairment can negatively impact the significant other (SO), as well as the individual with hearing loss. Although hearing aids improve communicative performance, they do not entirely remedy hearing dysfunction. Factors such as patient pre-use expectations have been shown to impact post-use satisfaction. It is thus logical to assume then that the SO's pre-use expectations and perhaps also post-use satisfaction may impact hearing aid outcome. At this time, however, these factors have yet to be examined. The purpose of this investigation is to put in place the tools for examining the pre-use expectations of, and the post-use satisfaction with, hearing aids from the SO's perspective by developing assessment questionnaires. To accomplish this task, two routinely used and standardized questionnaires, the Expected Consequences of Hearing aid Ownership (ECHO) and the Satisfaction with Amplification in Daily Living (SADL) will be used as a starting point and adapted accordingly. Pilot questionnaires will be developed based upon these questionnaires and from information obtained during interviews with non hearing-impaired SOs of individuals with mild to moderately-severe sensorineural hearing loss. Analyses of factor structure and reliability will be assessed for each questionnaire. These questionnaires will allow hearing professionals to assess the impact that hearing aids have on the individual with hearing loss, as well as his/her SO. With this information, they will be better able to tailor their counseling to the needs of the family unit and better understand the relationship between the perceptions of the SO and user outcome.

Plan: Two questionnaires will be developed for clinical use with the SO. The first questionnaire will query the SO regarding his/her pre-use expectations about hearing aid outcome. The second questionnaire will query the post-use satisfaction experienced by the SO with amplification. The questionnaires will be developed modeling the format of the ECHO and the SADL and adapted to the SO's perspective. Additional questions will be developed and current questions modified using data collected during interviews with non hearing-impaired SOs of individuals with hearing impairment and their hearing-impaired partners. Data obtained from these interviews will be coded into common themes and used for questionnaire development. The psychometric properties of these questionnaires will be evaluated.

Methods: In order to create two questionnaires for clinical use with the SO, this project will be completed in two phases. In the first phase, spousal pairs in which the individual with hearing impairment is considering getting hearing aids will be interviewed in order to develop pilot questionnaires. Once these questionnaires are developed, non-impaired SOs will complete both sets of questionnaires. The pre-use expectation questionnaire will be completed prior to the partner with hearing impairment receiving a hearing aid and the post-use questionnaire will be completed six weeks after the hearing aid is fit. Analyses of the psychometric properties of these questionnaires will be conducted using factor analysis. The test-retest reliability of the questionnaires will be assessed.

Findings to date: Data collection for the first phase of this investigation is currently underway.

Title: A Biological Interface for Rehabilitation with a Cochlear Implant

Principal Investigators: Allen F. Ryan, PhD; Stephen A. Fausti, PhD

Funding Agency: VA RR&D

Total Funding Received: \$660,000

Timeframe: 04/01/05 – 03/31/08

Objectives: The cochlear implant employs electrical stimulation to activate auditory neurons in patients that have lost their hearing due to the death of inner ear sensory cells. This device is now widely used to treat the deaf, and is increasingly used for patients with small amounts of residual hearing. It provides substantial benefit for the profoundly deaf, but the performance of even the most successful patients is far lower than that achieved by normal hearing listeners. In addition, there have been recent concerns regarding infection that can lead to meningitis. The proposed research program is designed to improve the cochlear implant by combining device engineering and biological approaches. Performance will be enhanced by decreasing the distance between the electrodes and cochlear neurons, so that more channels of information can be delivered, and by increasing the survival of cochlear neurons. Improving the seal around the base of the implant, to exclude infection, will enhance safety. These goals will be achieved by producing a biological interface between the implant and the tissues of the inner ear.

The general principles studied in this program will also be applicable to other health problems of veterans. Improved interfaces between electrode arrays and neurons could also be applied to veterans with visual deficits and in spinal cord injury.

Plan: The first phase of this program is to identify factors to which the tissues of the cochlea will respond with growth toward, and adherence too, implant materials. Experiments are proposed to explore the guidance of nerve fibers from cochlear neurons toward the implant using soluble factors, extracellular matrix molecules and repulsive signaling molecules. Additional studies will evaluate the growth of neurites through three-dimensional substrates that can link a cochlear implant to the region of the spiral ganglion. Further studies will develop artificial sensory epithelia in order to maintain cochlear nerve fibers at the surface of the implant.

Methods: Identification of factors critical for the growth of spiral ganglion neurites are first evaluated in vitro. Explants of adult spiral ganglion are exposed to soluble and surface-bound factors that can serve as growth substrates or provide guidance for nerve fibers. Factors that prove successful in vitro will then be tested in vivo by introducing them into the adult cochlea.

Findings to date: Thus far we have established the response profiles of adult spiral ganglion neurons to neurotrophins, including neurotrophin-3 (NT-3) and brain-derived neurotrophic factor (BDNF). We have also established the requirement of neurites for a co-receptor in order to achieve maximal responses with glial-derived neurotrophic factor (GDNF). We have developed procedures for engineering growth substrate patterns, so that neurites can be channeled along preferred paths. We have established procedures for testing directional guidance induced by soluble factors, and are evaluating several factors. We have developed three-dimensional matrixes that support neurite growth through fluid spaces.

Title: Individualized Objective Measures for the Early Detection of Ototoxicity

Principal Investigator: Stephen A. Fausti, PhD; Curtin R. Mitchell, PhD

Funding Agency: VA RR&D (conditional approval)

Total Requested Funding: \$322,200

Timeframe: Pending determination of start date (three years requested)

Objectives: There are over 200 medications that can adversely affect hearing. Therapeutic treatment with ototoxic drugs, particularly the aminoglycoside antibiotics and the chemotherapeutic agent cisplatin, can produce cochlear damage. Patients receiving these ototoxic drugs are at risk for incurring irreversible hearing loss that can adversely affect communication abilities. There is a clear need for a time-efficient, objective testing protocol to provide early detection of ototoxic-induced hearing impairment in patients who are unable to respond reliably to behavioral auditory tests.

This proposal will investigate and establish objective testing protocols suitable for clinical evaluation of all patients receiving ototoxic drugs. The effectiveness of individualized narrow-band auditory brainstem response (ABR) and fine resolution distortion product otoacoustic emission (DPOAE) will be evaluated relative to pure tone behavioral thresholds, the “gold” standard for early detection of ototoxicity. In order to develop an objective, clinically useful monitoring tool for early detection of ototoxic processes, the following objectives will be addressed: 1) to determine the extent to which individualized narrow-band ABRs and fine resolution DPOAEs provide early identification of hearing sensitivity changes in patients receiving ototoxic drugs. This will be accomplished by comparing changes in narrow-band ABRs and fine resolution DPOAEs to changes identified in behavioral pure-tone thresholds; 2) to determine which of the two individualized objective methods, narrow-band ABRs or fine resolution DPOAEs, provide the earliest evidence of change in relation to behavioral test results. The time of change occurring for the ABR and DPOAE methods will be compared to the time of change for the behavioral tests; and 3) to determine if the most effective individualized objective measure for early detection of ototoxicity established in the research laboratory is as reliable and sensitive on the hospital ward.

Methods: Individualized narrow-band ABR and fine resolution DPOAE data will be collected in conjunction with 1/6th octave behavioral data in a large sample of patients who are at risk for developing ototoxicity. Equipment has been modified to maximize effective testing methods. During drug treatment, individualized narrow-band ABR and fine resolution DPOAE objective testing protocols will be used to assess hearing function within each patient’s individualized sensitive range for ototoxicity. Behavioral threshold test results will be compared with narrow-band ABR and fine resolution DPOAE measures of hearing function. A comparison will be made between the changes in hearing sensitivity measured behaviorally with the changes in hearing function estimated by the fine resolution DPOAEs and the narrow-band ABRs. These comparisons will be made from results obtained in the laboratory and then the most effective measure will be tested at bedside with a portable unit.

Findings to date: There are no findings to report at this time as this proposal has received a fundable score and is pending an initiation date.

Title: Randomized Trial of a Brief Patient-Centered Aural Rehabilitation Model

Principal Investigators: Mitchel B. Turbin, PhD; Harvey B. Abrams, PhD

Funding Agency: VA RR&D (conditional approval)

Total Requested Funding: \$465,000

Timeframe: Pending determination of start date (three years requested)

Objectives: This clinical trial explores the efficacy of a brief aural rehabilitation (AR) intervention: The Living Well with Hearing Loss Workshop. The workshop (to be developed) will be a 2 hour interactive session for 4-8 veterans that will address specific hearing related issues presented by the participants themselves as well as teaching problem-solving and emotion-focused coping skills. Our outcome measures will tell us whether adding this treatment to the standard VA audiology protocol will result in reductions in hearing handicaps and increases in patient self-management of hearing disability. If treatment efficacy is confirmed, a cost-effective treatment modality will be made available for use by VA audiologists to enhance patient outcomes, and will also be suitable for adaptation for use in online or video patient education programs.

Plan: This three year, dual site study will be conducted at the Portland VAMC and the Bay Pines Florida VAMC. Three hundred and ten veterans will be recruited from the Audiology Clinics at these medical centers who are in the process of receiving their first hearing aids from the VA Hearing Aid program. Questionnaires will be administered before patients are fitted with their hearing aids, and readministered 8 weeks and 6 months after hearing aid fitting. One half of the subject pool will be randomized to attend the AR workshops 4 weeks after hearing aid fitting; the control subjects will receive normative VA audiology services alone.

Methods: This is a fully randomized parallel design. In addition to the Co-PIs, the study will employ a 1.0 FTEE Research Assistant and a fee-per-session Audiologist Workshop Facilitator at each site. Randomization will be conducted by clinic receptionists after hearing aid fitting to ensure "blinding" of the Research Assistants, who will administer the outcome measures. Outcome questionnaires will measure both trait (personality) and state (coping skills) specific responses to hearing loss before hearing aid treatment, after AR treatment (for experimental treatment subjects) and sort term (8 weeks) and longer term (6 months). The AR workshops will utilize a variety of multi-media to enrich the learning experience. Co-PI Dr. Turbin in Portland will be primarily responsible for compiling a training manual to be used to educate the Workshop Facilitator in the specifics of this patient-centered coping skills model of AR. A consortium of 4 nationally renowned consultants, with expertise in audiology, behavioral medicine and psychology, will serve to substantially enhance the quality of our curriculum, both for training our facilitators and for the workshop content and process. Our Biostatistician will have ongoing responsibility for monitoring data integrity and analysis.

Findings to date: There are no findings to report as the start date and subsequent data collection for this project have yet to be established. However, use of the patient-centered model has been empirically validated in behavioral medicine, where it has been found to reduce medical costs and enhance patient satisfaction and self-management of illness and health care. While coping skills training has been widely used in rehabilitative audiology and in psychological and peer-mentor interventions with hearing impaired persons, this will be the first large scale controlled clinical trial of that methodology.

Title: Viral Induced Sensorineural Hearing Loss: A New Treatment Strategy

Principal Investigator: Steven H. Hefeneider, PhD

Co-Investigator: Dennis R. Trune, PhD

Funding Agency: VA RR&D

Total Funding Received: \$660,000

Timeframe: 10/01/05 – 09/30/08

Objectives: Sudden sensorineural hearing loss (SSNHL) is characterized by hearing impairment or deafness that develops during a short period of time. The hearing loss is frequently associated with vestibular disturbances, tinnitus and a pressure sensation in the ear. The etiology of SSNHL is not well defined and a variety of causes have been hypothesized. Viral infection has been reported as an underlying cause and is supported by serologic and histopathologic studies. The mechanism of viral induced hearing loss is hypothesized to be induction of inner ear inflammation. Inflammatory cytokines produced in response to viral disease may interrupt the hair cell and ion homeostatic pathways in the cochlea, resulting in a decrease in function and eventual death of hair cells. The objective of the study is to develop an animal model of viral labyrinthitis and determine the impact of immune suppression therapies on the progression and extent of hearing loss.

Plan: Recently, a protein from vaccinia virus, termed A52R was reported to inhibit intracellular signaling initiated by PAMP/TLR interaction, resulting in reduced secretion of proinflammatory cytokines produced by immune cells in response to bacterial and viral products. We generated peptide derivatives from the A52R protein and showed that one of these peptides, termed P13, demonstrated significant inhibition of *in vitro* cytokine production in response to bacterial and viral components. Both bacterial and viral products activate the same intracellular pro-inflammatory pathway, via TLRs. The current proposal will examine the effect of peptide P13 therapy on viral induced inner ear inflammation.

Aim 1: Establish *in vivo* the effectiveness of peptide P13 to inhibit actuation of a viral induced inflammatory response, and

Aim 2: Determine the effectiveness of peptide P13 to reduce inner ear inflammation and limit hearing loss in an animal model of viral induced inner ear disease.

Methods: Aim 1 will determine whether peptide P13 inhibits pro-inflammatory cytokine secretion from virally stimulated cells *in vitro*. Established cell lines will be incubated with various concentrations of virus involved in inner ear inflammation and production of pro-inflammatory cytokine secretion quantified by ELISA. Once optimal *in vitro* parameters are established, peptide P13 and a control scrambled peptide will be added simultaneously with the virus and inhibition of pro-inflammatory cytokine secretion determined. Aim 2 will determine whether peptide P13 will limit inflammation and restore hearing thresholds in an animal model of viral induced inner ear disease. Animals will receive bilateral viral injections, one ear with PBS and the opposite ear with various doses of peptide P13. After seven days, hearing levels will again be assessed by ABR, animals will be euthanized and inner ear tissues evaluated histologically for inner ear inflammation.

Findings to date: There are no data to report as this project was just recently initiated.

Title: The Impact of Hearing Aid Directional Microphones on Sound Localization

Principal Investigator: Gabrielle H. Saunders, PhD

Funding Agency: VA RR&D

Total Funding Received: \$484,800

Timeframe: 01/01/05 – 12/31/07

Objectives: The purpose of this study is to investigate the impact hearing aid directional microphones have upon sound localization and speech intelligibility. The use of directional hearing aids represents a promising approach to the problem of speech in noise, but these instruments also impose constraints, such as reduced localization cues. It is important to evaluate both the advantages and limitations of directional hearing aids under realistic conditions of use. The issues to be addressed in the proposed research include an assessment of the magnitude of the improvement in intelligibility, the relative loss in localization ability and its practical consequences (if any) and other possible limitations that may be encountered in the everyday use of directional hearing aids.

Plan: This investigation will compare performance with directional microphones and omnidirectional microphones. Specifically, this investigation will: 1) document the impact of omnidirectional, cardioid and supercardioid microphone polar patterns upon sound localization; 2) evaluate the effect of these microphone polar patterns on speech intelligibility in noise; and 3) determine whether sound localization and speech intelligibility in noise changes differentially over the first few weeks of use for individuals wearing hearing aids with directional versus omnidirectional microphones.

Methods: Seventy subjects will undergo routine audiometric testing, an evaluation of sound localization for low, mid- and high-frequency signals and measurement of speech intelligibility in noise. All subjects will then be fit with a pair of in-the-ear hearing aids with selectable microphone polar patterns. They will undergo aided sound localization testing and speech intelligibility testing, with the microphone polar pattern in the omnidirectional, cardioid and supercardioid modes. Following testing, subjects will be randomly assigned to one of two groups (1) those who will wear the hearing aids in the omnidirectional mode for 24 weeks and (2) those who will wear the hearing aids in the cardioid mode for 24 weeks. Following this, subjects will return to the laboratory for sound localization and speech intelligibility in noise testing.

Findings to date: Hardware and software development is completed for measurement of hearing aid polar patterns and for speech intelligibility testing. Subject enrollment is to commence soon.

Title: The Performance-Perceptual test (PPT) as a Counseling Tool

Principal Investigator: Gabrielle H. Saunders, PhD

Co-Principal Investigator: David J. Lilly, PhD

Funding Agency: VA RR&D

Total Funding Received: \$249,800

Timeframe: 07/01/05 – 06/30/07

Objectives: Hearing aid dissatisfaction continues to be disappointingly high, even though technology has improved dramatically over the last 10 years or so. Unfortunately, the results of most commonly used self-report measures cannot be directly compared with the results from performance measures since the modes of testing are very different. Thus, it is hard for clinicians to reconcile data from individuals reporting more handicap or less hearing aid satisfaction than would be expected from their performance. In this study, we aim to use a test known as the Performance-Perceptual Test (PPT) to determine whether simple counseling based upon discussion of PPT results can be used to better align perceived and measured ability to understand speech-in-noise and, more importantly, whether such counseling can decrease reported handicap and improve hearing aid satisfaction, regardless of its impact upon perceived hearing ability.

Plan: The study will be conducted over a two-year period. We will determine whether PPT-based counseling can decrease reported handicap and increase hearing aid satisfaction among individuals that underestimate their hearing ability and their hearing aid benefit. The following questions will be addressed: 1) Does a combination of the Performance SRTN and the PPDIS explain the variance in aided reported handicap to the same extent that it explains the variance in unaided reported handicap? 2) Can simple counseling based upon an individual's PPT scores better align an individual's perception of his/her hearing ability with his/her actual hearing ability? 3) Can this counseling successfully decrease unaided and/or aided reported handicap in individuals that underestimate their hearing ability and report excessive handicap for their degree of impairment? 4) Can PPT-based counseling increase satisfaction with hearing aids among hearing aid users that underestimate their hearing aid benefit?

Methods: Hearing aid users will complete the PPT for aided and unaided listening, along with standardized questionnaires measuring reported auditory disability, handicap and hearing aid satisfaction. Following this, subjects will be randomly assigned to one of two groups. Subjects in Group 1 will receive counseling from the experimenter in the form of an explanation and discussion of their PPT results. Subjects in Group 2 will also participate in a discussion with the experimenter, but it will not include an explanation of the PPDIS. Two weeks after enrollment in the study subjects will complete a second set of questionnaires. Ten weeks after study enrollment subjects will return to the laboratory to rerun the test battery. The impact of the counseling upon PPDIS values, reported handicap and hearing aid satisfaction and benefit will be compared across the two groups.

Findings to date: Five subjects have been enrolled for the study. Their data is not yet complete. However, pilot data from six individuals revealed that all individuals were highly appreciative of the counseling; and five said they could identify with our explanation of their PPDIS value. Of these, three later noticed that they did under/ overestimate their hearing ability in daily life and put into practice our recommendations are no findings to report at this time.

Title: Senior Research Career Scientist Award

Principal Investigator: Marjorie R. Leek, PhD

Funding Agency: VA RR&D

Total Funding Received: \$1,190,210

Timeline: 10/01/05 – 09/31/12

Objectives: The goal of this award is to provide salary support for a senior clinical scientist who will contribute to the research program of the VA and the NCRAR through research and leadership activities. The holder of this award provides mentoring and scientific training to junior VA scientists, maintains an active research program relevant to the mission of the organization and to veterans' health care, serves as a resource to the research community, collaborates with other scientists and clinicians, and serves on VA research and other committees.

Plan: Research will be carried out to determine the functional mechanisms of hearing loss and their involvement in deficits in speech understanding by hearing impaired veterans. This work is currently supported by an NIH R01 grant that has been funded for nearly twenty years. Further research funding has been awarded from the Oticon Foundation for a collaborative project with scientists at Walter Reed Army Medical Center to determine the benefit of providing individualized auditory computer models to characterize a patient's impaired hearing, with the ultimate goal of developing improved signal processing in hearing aids. Additional research proposals are under development. Active mentoring is underway for an young scientist who has just been awarded a VA RR&D Associate Investigator Award and for another staff scientists at the NCRAR who currently holds a Research Career Development Award.

Methods: The implementation of the SRCS award involves preparing grant applications and designing research; developing laboratory resources and hiring and mentoring post doctoral research associates; providing service to national and local professional organizations including reviews of articles and grant proposals; and publishing research findings in national journals and at national meetings.

Findings to date: To date, Dr. Leek's NIH grant is currently being transferred to the Oregon Health & Science University to support the research of the SRCS. Approvals from the Institutional Review Boards at the Portland VA Medical Center and the Oregon Health & Science University have been obtained, and data collection will begin with the next few months. In addition, the collaboration with Walter Reed Army Medical Center has been established, and preparations to begin the projects on the Oticon Foundation grant are underway. The laboratory is nearly ready to be set up with equipment, followed by calibrations and pilot data collection.

Ongoing VA Funding (n = 15; total funding received = \$11,136,107)

Title: Veterans Affairs National Center for Rehabilitative Auditory Research (NCRAR)

Principal Investigators: Stephen A. Fausti, PhD; Dennis N. Bourdette, MD

Funding Agency: VA RR&D

Total Funding Received: \$4,150,000

Timeframe: 10/01/02 – 09/30/07

Objectives: According to the most recent figures available from the Veterans Benefits Administration (VBA), auditory disabilities represent the most prevalent individual service-connected disability among veterans receiving compensation in fiscal year 2004, affecting some 742,211 individuals. Of this number, nearly 375,400 veterans were service-connected at 10% or more for their auditory disability and therefore received compensation benefits from the VBA that totaled more than \$400 million. It is further estimated that an additional 1,600,000 veterans have a secondary service-connected disability for hearing loss at less than 10%, which although is not a compensable level, has created a tremendous demand for hearing health care services within the VA health care system. Among veterans with compensable service-connected disabilities, one in seven is service-connected for hearing loss and/or tinnitus, and the annual number of veterans who begin to receive compensation for hearing impairment continues to increase dramatically. According to the VBA, between 2000 and 2004, the number of veterans receiving compensation for hearing impairment increased 168 percent. In fiscal year 2004 the VA spent over \$119 million to purchase 315,224 hearing aids. This does not include personnel costs associated with delivery of service and long-term patient management—estimated at \$300 million per year. Furthermore, there was more than \$418 million paid in compensation benefits to veterans specifically for tinnitus. The combined compensation benefits and rehabilitation service costs associated with rehabilitating auditory impairments including hearing loss and tinnitus exceeds \$1 billion annually. The NCRAR is the only national Center of Excellence dedicated solely to addressing the needs of veterans with hearing impairment and tinnitus.

Research Plan: There is a tremendous public health need for widespread implementation of hearing loss prevention strategies, evidence-based aural rehabilitation best practices, and innovative, useful technologies to eliminate or alleviate the emotional, financial, social and vocational consequences of hearing loss. This can be accomplished by education to prevent hearing loss as well as through research that determines causes of and evidence-based treatments for hearing loss, which can be translated into clinical practice.

Methods: Research at the NCRAR focuses on auditory rehabilitation. In order to optimize auditory rehabilitation, however, research on diagnosis and prevention also are necessary. Effective rehabilitation requires an accurate diagnosis of the condition and a valid and reliable measurement of the resultant deficit. Prevention of hearing loss is preferable to, and more cost effective than, intervention. The three major research areas at the NCRAR therefore include: a) rehabilitative devices and techniques; b) diagnosis and assessment; and c) hearing loss prevention and hearing conservation.

Findings to date: The NCRAR has been exceptionally successful in building VA rehabilitation research capacity, in developing new rehabilitation strategies and innovative technologies, and in translating evidence-based research results into practice. The NCRAR has established itself as a national leader in increasing knowledge about hearing impairment and improving the hearing health and care for veterans and the nation.

Title: Effects of Age and Noise on Peripheral Auditory Processing in Relation to Speech Recognition

Principal Investigator: Dawn L. Konrad-Martin, PhD

Funding Agency: VA RR&D

Total Funding Received: \$294,267

Timeframe: 07/01/03 – 06/30/06

Objectives: The goal of this Research Career Development (RCD) Grant is to provide training to allow this new investigator to secure independent funding for a program of research aimed at understanding the influence of aging and noise over-exposure on peripheral auditory system function in humans. Research aims include 1) determining effects of age and noise exposure on outer-hair cell-assisted basilar membrane function and inner hair cell/auditory nerve transduction; and 2) determining whether speech recognition in noise is correlated with pre-neural (basilar membrane) or auditory nerve responses in young and elderly individuals with and without hearing loss.

Plan: To accomplish these aims, results of subjects on speech tests designed to tax subjects' speech recognition ability will be compared to cochlear (otoacoustic emission) and neural (compound action potential) responses to make inferences about the relation between speech recognition and peripheral auditory system function.

Methods: Fifty elderly subjects will be 63 to 85 years old with cochlear hearing loss (high frequency pure-tone-average [HFPTA] = 30-50 dB HL). Young subjects will be 18 to 35 years old. Fifty young subjects will have normal hearing and 50 will have noise-induced hearing loss (HFPTA = 30-50 dB HL). Up to 50 individuals will serve as pilot subjects. Procedures include standard pure-tone audiometric assessment, speech recognition testing, and otoacoustic emission (OAE) and compound action potential (CAP) measurements. Speech recognition will be examined using a speech in noise test. OAE stimuli will be continuous tones and tone pips generated by a custom OAE measurement system. OAE correlates of growth functions, tuning curves, and masking patterns will be generated from the OAE data. Auditory nerve correlates of response growth and masking patterns also will be assessed using CAP responses elicited by tone bursts in quiet and in the presence of a filtered noise.

Findings to date: We have collected SFOAE data in 20 young-normal and elderly-normal ears. Since the optimal OAE stimulus paradigm for pip-evoked OAEs was not clear *a priori*, three tone-pip evoked OAE stimulus paradigms were tested in these subjects, tone-pip pairs separated in frequency by 3% or 6%, and continuous tones paired with tone pips. This research comparing results in young and elderly adults builds on experiments used to test the prediction that SFOAE latencies and cochlear tuning are linked. SFOAE latencies were obtained as a function of frequency and level in normal and impaired ears. Level-dependent shifts in SFOAE latency were observed in normal, but not in impaired ears, providing evidence that the non-invasive SFOAE measure of latency can be used to estimate cochlear tuning. One publication (Konrad-Martin and Keefe, 2005), 2 presentations on SFOAEs, and an NIH R03 grant submission have resulted from this research this year. Because Stephen Fausti, PhD is Primary Mentor for this grant, Dr. Konrad-Martin is involved with his VA RR&D ototoxicity-monitoring studies. Through this collaboration, she is applying physiological measures of hearing function that she developed in the laboratory to a large clinical population, gaining experience coordinating a multi-site clinical study, and developing ototoxicity-monitoring protocols for the VA Audiology Clinic. This year alone, results of this collaboration include 5 presentations and 7 manuscripts.

Title: Therapy for Inflammation and Fluid Accumulation in Otitis Media

Principal Investigator: Steven H. Hefeneider, PhD

Co-Investigator: Dennis Trune, PhD

Funding Agency: VA RR&D

Total Funding Received: \$651,400

Timeframe: 10/01/02 – 09/30/05

Objectives: The goal of this proposal was to develop an adjuvant intervention therapy to minimize or resolve the inflammation and resulting accumulation of middle ear fluid, and prevent the hearing loss in OME. Our strategy was to block at the initiating stage, the cell-surface binding of those bacterial products that have been documented to induce middle ear inflammation. We speculated this new treatment would prevent or minimize the clinical complications of OME. Blocking bacterial-induced cellular activation would control inflammation within the middle ear and this would prevent or minimize the fluid accumulation and subsequent hearing loss associated with OME. This study took advantage of several recent studies that defined both the immunology and biology by which bacteria induce activation leading to tissue inflammation.

Plan: Initial studies established conditions for blocking inflammation induced both by specific bacterial products and cell extracts from killed whole bacteria, as assessed by cell activation, using a human cell line. Once these conditions were defined in vitro (*Specific Aim 1*), the in vivo effectiveness of this therapy to minimize inflammation was examined by assessing middle ear pathology, middle ear fluid accumulation, and prevention of hearing loss in an in vivo mouse model of OME induced by injection of viable bacteria (*Specific Aim 2*).

Aim 1: Determine whether blocking of the binding of bacterial products to host immune cells will reduce or eliminate the release of inflammatory mediators in an in vitro model system where cell activation is induced both by specific bacterial products and by cell extracts from killed whole bacteria.

Aim 2: Determine whether blocking the interaction of bacterial products with host immune cells will minimize inflammatory middle ear pathology, reduce fluid accumulation, and prevent hearing loss in an in vivo model of OME induced by injection of viable bacteria.

Methods: Mice were inoculated with heat-killed bacteria and the impact of blocking at the cell-surface, the interaction of bacterial products with host immune cell receptors, was determined with ABR audiometry, histopathology, immune cell cytokine characterization, immuno-histochemistry, and electron microscopy.

Findings: A mouse model for otitis media was developed and dose-response curves to bacterial infections were established. A new approach for blocking inflammation associated with otitis media was developed and examined using the in vivo mouse model system. Effective insertion peptides have been developed that enter inflammatory cells and suppress the inflammation cascade.

Title: Effect of Individualized Counseling on Hearing Aid Acceptance

Principal Investigator: Gabrielle H. Saunders, PhD

Co-Principal Investigator: Stephen A. Fausti, PhD

Funding Agency: VA RR&D

Total Funding Received: \$391,700

Timeframe: 04/01/02 – 03/31/05

Objectives: Despite substantial advances in hearing aid technology, consumer satisfaction has remained steady. It thus appears that hearing aid use is influenced as much by psychosocial issues as by the performance of the hearing aid. Improved acceptance and uptake of hearing aids may be achieved if there were a tool available that allowed clinicians to identify some of the negative attitudes associated with poor uptake and use and a means by which he/she could intervene to alter these attitudes. The tool used in this study is the Attitudes to Loss of Hearing Questionnaire (ALHQ) developed by the investigators (Saunders and Cienkowski 1996). The specific objectives of this study are (a) to refine the ALHQ to improve reliability of certain subscales, (b) to design and test a program for computerized administration of the questionnaire and (c) to develop a counseling program based upon responses to the ALHQ that aims to change negative attitudes and thus increase hearing aid uptake and use.

Plan: The study is taking place at the National Center for Rehabilitative Auditory Research (NCRAR), Portland OR and at the University of Connecticut, Storrs, CT. It has 3 stages: (1) Refinement of the ALHQ, (2) Development of an electronic version of the ALHQ and (3) Development of a personalized counseling program.

Methods: Collection of normative data and test-retest reliability data has been completed. Participants each completed the ALHQ v2.1. Factor analyses and reliability analyses were conducted to extract the most reliable scales. Development and evaluation of the electronic version of the questionnaire is also completed. For this, subjects completed the ALHQ on two occasions in paper form or in electronic form. The relative variability for each version was compared. The personalized counseling program is under development. The program is based upon the five ALHQ scales. Input for content was provided by the study consultants and practicing audiologists. Furthermore, the routine counseling provided by three practicing clinicians was taped and analyzed in order to ensure that the ALHQ personalized counseling is an improvement over routine counseling.

Findings: The new questionnaire structure has been finalized and is described in Saunders et al, Journal of the American Academy of Audiology, in Press). Three of the original five subscales have remained stable while two changed in their composition. These new subscales retain face validity and appear to measure factors that may be predictive of hearing aid satisfaction and use. The electronic ALHQ has also been developed and evaluated. These data are described in Saunders et al (American Journal of Audiology, in submission). Analyses show that scores obtained on the questionnaire are not impacted by method of questionnaire completion but that variability of scores is greater when different modes of completion are used at test and retest as compared to using the same mode on both occasions. Data also show that scores on the ALHQ are correlated with reported hearing aid outcome such that negative attitudes are associated with lower hearing aid satisfaction and fewer hours of daily hearing aid use.

Title: A Method for Improving Localization Abilities of the Hearing and Visually Impaired

Principal Investigator: Gabrielle H. Saunders, PhD

Funding Agency: VA RR&D

Total Funding Received: \$205,900

Timeframe: 01/01/03 – 12/30/05

Objectives: Hearing and vision losses are common among older Americans. According to a report from the Centers for Disease Control at least 1.7 million people report both hearing and vision loss. The auditory system is dependent on interaural amplitude and phase differences for directional information. The need for accurate directional cues is even greater for veterans with both peripheral vision loss and hearing loss since, in the absence of visual directional cues, these veterans are critically dependent on auditory directional cues. The objective of this study is to investigate the interactions between hearing loss and aging upon sound localization ability.

Plan: This study is a collaborative study between investigators at the National Center for Rehabilitative Auditory Research and investigators at the Center for Aging with Vision Loss. A highly flexible system for testing sound localization was developed that enables localization ability to be tested for signals originating from up to 24 different locations, using any sound file that can be stored on the computer. It consists of software that controls signal output from a computer via four sound cards and four amplifiers to twenty-four loudspeakers. The software allows the user to select the number of speakers, to specify their location, to select the stimulus and to select the number of times the stimulus will be presented from each loudspeaker during an experimental run. Additionally, the software controls a sound level meter and the sound card settings so that the signal from each loudspeaker can be automatically calibrated to any specified degree of accuracy. The sound localization ability and speech recognition ability in noise will be compared for 3 groups of subjects: (1) young subjects with normal hearing; (2) older subjects with normal hearing and (3) older subjects with hearing impairment.

Methods: Subject testing has been conducted at the National Center for Rehabilitative Auditory Research (NCRAR) at Portland VAMC and at the Center for Aging with Vision Loss (CAVL) in Atlanta GA. Localization testing was carried out with 4 different test stimuli: three narrowband noises (0.25-0.5 kHz, 1-2 kHz and 3-4 kHz) and a speech-shaped noise. Responses were stored in an access database for later analysis. In addition to the localization task, subjects underwent routine audiometric assessment and speech recognition tests.

Findings: All data collection at the NCRAR is complete. Data have shown that the localization task is reliable (high test-retest correlations) and that subjects can carry out the task easily. The localization abilities of the young normal hearing individuals were superior to those of the two groups of older listeners; the localization abilities of the two older subject groups did not differ. It is concluded that aging affects localization abilities to a greater extent than does sensorineural hearing loss.

Title: RR&D Disability Supplement Award – Mitchel Turbin, PhD

Principal Investigator: Gabrielle H. Saunders, PhD

Funding Agency: VA RR&D

Total Funding Received: \$236,100

Timeframe: 11/01/02 – 10/31/05

Objectives: The VA RR&D National Center for Rehabilitative Auditory Research (NCRAR) in Portland, OR provided mentoring and training to Mitchel B. Turbin, PhD for three years under the RR&D Disability Supplement, with the aim of his becoming a highly trained independent researcher. Dr. Turbin's clinical and research interests include the issues of emotional, behavioral and social barriers faced by people with hearing loss, interests that are highly compatible with the mission of the NCRAR. In addition to mentors, the NCRAR can provide support staff, research facilities and access to scientific literature and to scientists in many disciplines.

Plan: The following plan has been prepared for the applicant, encompassing three areas of development:

Mentoring: Dr. Turbin will work with his primary mentors, who will select and plan detailed activities, such as literature reviews and recommendations for participation in various courses. They will also ensure that the applicant has the opportunity to interface with diverse professional expertise available at the NCRAR and other local departments;

Supervised Research: Dr. Turbin will observe and participate as a Research Assistant for a multitude of ongoing NCRAR studies; and

Independent Research: Dr. Turbin will prepare a submission for a merit reviewed grant application and will collect pilot data for this study in order to enhance the proposal. Mentoring regarding the preparation, content and writing of this proposal will be provided throughout.

Methods: Dr. Turbin continued structured readings in the literature, and met with Drs. Fausti and Henry on a periodic basis to receive guidance and mentoring on rehabilitation research and clinical methodology. He also received mentoring on statistical methods from Dr. Kenneth James, and received additional mentoring from Dr. Daniel Storzbach in the Mental Health Clinic on issues specific to his area of concentration. Dr. Turbin also spent time in the Audiology Clinic observing the audiologic clinical practices performed by clinical audiologists who treated a wide variety of hearing impaired veterans.

Findings: During the third and final year of Dr. Turbin's RR&D Disability Supplement Award, he worked with Dr. Harvey Abrams, Chief of Audiology at the Bay Pines VAMC, Dr. Theresa Chisolm of the University of South Florida, as well as Drs. Stephen Fausti, James Henry and Kenneth James of the NCRAR to develop and submit an LOI to the RR&D service entitled, "Evaluation of a Brief Group Aural Rehabilitation Treatment" in March 2005. The study proposed a randomized dual site parallel investigation comparing typical VA audiology (hearing aid rehabilitation alone) with typical VA audiology plus a one-session group Aural Rehabilitation intervention. Dr. Turbin's LOI was accepted and culminated in the submission of full merit review proposal, "Randomized Trial of a Brief Patient-Centered Aural Rehabilitation Model" in June 2005, which received conditional approval for funding. Dr. Turbin is now a successfully funded NCRAR investigator, and will initiate data collection at both the Portland, OR and Bay Pines, FL VAMCs after the start date for this new merit review project has been established.

Title: Randomized Clinical Trial to Assess Benefit of Group Therapy for Tinnitus

Principal Investigators: James A. Henry, PhD; Carl F. Loovis, PhD

Funding Agency: VA RR&D

Total Funding Received: \$429,069

Timeframe: 07/01/02 – 06/30/05

Objectives: Tinnitus has become a major problem for veterans and for the Veterans Health Administration. In 2001 tinnitus was the most common disability among veterans who began receiving disability compensation (VBA Annual Benefits report). In 2004, over 289,000 veterans received over \$345,000,000 in compensation benefits solely for their service-connected tinnitus (Office of Policy and Planning, VA Central Office). In spite of the magnitude of the problem, most VA medical centers do not provide clinical management for veterans with problematic tinnitus.

An outcomes study was recently completed at the Portland VAMC to evaluate two individualized long-term treatment methods, which are both effective for the majority of veterans with problematic tinnitus. It was hypothesized that many veterans with less severe tinnitus would receive significant benefit from basic education and counseling, which could be provided in a group format. The present study, completed in June 2005, was a randomized clinical trial to test this hypothesis.

Plan: Veterans with moderate to severe tinnitus were recruited from the Seattle, Washington area. The Puget Sound VA Health Care System has never had a formal tinnitus treatment program, making this an ideal population for this trial. The study planned to enroll 300 veterans, of which 100 would be randomized into each of three groups: 1) expert-led group therapy; 2) traditional support group; and 3) usual care. The expert-led group was led by audiologists formally trained in Tinnitus Retraining Therapy (TRT). The support group used a traditional support-group format of discussion from group participants led by a moderator who had no particular tinnitus expertise. For the usual care group, there was no intervention.

Methods: After telephone screening, veterans who felt they were qualified first came to an Open House where the study was explained and consent was obtained. All participants then completed baseline questionnaires during the Open House. The questionnaires obtained information in two main areas: 1) demographic, socio-economic and medical history information; and 2) description and severity of tinnitus using several different instruments. Participants in the two treatment groups attended a weekly series of four group sessions lasting up to 1.5 hours each. Participants completing the questionnaires (mailed) concerning tinnitus severity at 1, 6, and 12 months following the final session. Participants in the usual care and traditional support groups were offered the series of expert-led sessions when they completed all questionnaires.

Findings: A total of 310 veterans were enrolled and randomized into one of the three groups. All group sessions have all been completed. Data analyses reveal that the expert-led group resulted in statistically greater long-term benefit for tinnitus sufferers than either the traditional support group or the usual-care group.

Title: The Effects of Cognitive Processing on Speech Recognition

Principal Investigator: Nancy E. Vaughan, PhD

Funding Agency: VA RR&D

Total Funding Received: \$511,150

Timeframe: 04/01/02 – 09/30/05

Objectives: The primary objective of this project is to examine whether age-related working memory deficits influence performance on time-compressed speech recognition in older listeners with and without accompanying hearing loss. An understanding of the effects of specific cognitive mechanisms involved in speech understanding would have a significant impact on aural rehabilitation therapy and on design of amplification devices (Crandell, 1991; Sommers, 1997).

Plan: Time-compressed speech recognition scores were used to divide our test population of older adults (50 to 75 years) into three groups of high, average and low scores. To obtain a working memory profile, three different neuropsychological tests and two reliable research paradigms were used. Additional tests of attention and processing speed were used to determine the potential interaction of these variables with working memory deficits.

Methods: An initial session of audiometric tests and cognitive screening tests was used to exclude from the study people with severe hearing loss, central auditory deficits, or dementia or depression. There were two Experimental Test Sessions – one for Speech Recognition Tests and the other for the Working Memory and Other Neuropsychological Tests. The two Experimental Test Sessions (Speech Recognition tests and Neuropsychological tests) were held on separate days no more than one month apart to avoid test fatigue.

Findings: Enrollment in this study was closed as of September 30, 2005. Three hundred and one participants were tested. Findings revealed that two major cognitive functions resulting from a principal components analysis (PCA) were strongly related to time-compressed speech recognition performance. People between the ages of 50 and 75 years who performed poorly on certain working memory tests also performed poorly on time-compressed speech tests. Further analyses are being conducted to explore more fully the age effects in this study and to describe cognitive profiles of the high and low performers. A paper entitled “Sequential versus non-Sequential Working Memory in Understanding of Rapid Speech by Older Listeners” is in press at *Journal of the American Academy of Audiology (JAAA)* scheduled for publication in June 2006. Further publications are planned.

Title: Auditory Function in Patients with and without Multiple Sclerosis

Principal Investigators: David J. Lilly, PhD; Stephen A. Fausti, PhD; Dennis N. Bourdette, MD

Funding Agency: VA RR&D

Total Funding Received: \$596,800

Timeframe: 04/01/02 – 03/31/06

Objectives: The nature of auditory dysfunction in patients with multiple sclerosis (MS) has not been identified clearly. It has been reported that 40% to 60% of MS patients with normal hearing sensitivity have difficulty hearing in everyday listening conditions. These reports are consistent with observations from clinicians that up to half of their patients have difficulty understanding speech, especially in a background of noise. These perceptual difficulties have been attributed to a variety of things, such as memory problems, fatigue or dementia. We hypothesized, however, that they may be due in part to auditory-processing deficits caused by focal loss or destruction of myelin sheath (demyelination) within the auditory nervous system. Our primary goal, then, is to characterize auditory function and cognitive function in patients with Multiple Sclerosis (MS).

Plan: We developed the requisite instrumentation and test materials to evaluate auditory function and neuropsychologic function in 150 MS patients and in 150 patients who do not have MS. Experimental subjects are being recruited by selecting patients with a verified diagnosis of MS from the registry of patients established by the Oregon Health & Science University, and the Portland VA Medical Center. Control subjects are being matched with respect to age, to sex and to audiometric configuration.

Methods: Three types of testing were employed. First, peripheral auditory function was evaluated using a comprehensive set of auditory tests. Second, sensitive measures of central auditory function were performed along with auditory evoked-potential studies. Third, subjects underwent a battery of neuropsychologic tests to assess functions frequently affected by MS, including domains of memory, attention, and conceptual reasoning. Specific hypotheses to be tested involve controlled comparisons between patients with MS and the control subjects.

Findings: Data acquisition was completed on December 30, 2005. During the course of this study we completed approximately 700 test sessions involving MS patients, control subjects, and pilot subjects. Five or six test sessions were completed on each MS patient and on his or her matched control. In general, we observed significant differences between the two groups on: 1) speech intelligibility in noise; 2) masking-level differences for a 500 Hz pure-tone; 3) the Staggered-Spondaic Word test; and 4) on the Dichotic Listening test. Evoked-potential data and otoacoustic emission data still are being reduced. Preliminary pilot data also have been obtained on a smaller subset of subjects using behavioral tests that are designed to evaluate central auditory function (CAP tests). These CAP tests have been incorporated into a future MS grant proposal.

Analysis of our pilot studies suggest differences in test performance between patients with MS and their controls on the following tests: (1) the Gaps-in-Noise Test (at 5-ms and 6-ms gap durations); (2) the Dichotic Digits Test (for the left ear); (3) the Auditory-Figure Ground subtest of the SCAN-A; (4) the Competing Words subtest of the SCAN-A; and (5) the Competing Sentences subtest of the SCAN-A. These results provide support for the existence of CAP deficits in patients with MS.

Data analysis currently is underway along with the preparation of manuscripts for publication.

Title: Comparison of Objective Measures for Early Detection of Ototoxicity

Principal Investigators: Stephen A. Fausti, PhD; David J. Lilly, PhD

Funding Agency: VA CSR&D

Total Funding Received: \$429,663

Timeframe: 04/01/01 – 09/30/05

Objectives: Therapeutic treatment with ototoxic drugs can produce damage to the inner ear creating irreversible hearing losses. Hearing loss from most ototoxic agents affects first the higher audible frequencies and progresses to lower frequencies. Therefore, serial testing of frequencies above 8000 Hz can provide early detection of damage. Since prevention is critical, this information can allow treatment alterations and preserve hearing in the speech range (5 – 4kHz). Approximately 30% of hospitalized patients receiving ototoxic drugs at this VAMC are unable to respond reliably to behavioral auditory tests, and therefore cannot be monitored for ototoxicity. The objectives of this prospective study were: 1) which of two objective methods [auditory-evoked potential (AEP), or otoacoustic-emission (OAE)] is most useful for early detection of ototoxic-induced cochlear damage; 2) whether time-efficient protocols affect test sensitivity and specificity; and 3) the overall efficacy of AEP and OAE techniques for early detection and monitoring of cochlear damage in patients.

Plan: This study collected AEP and OAE data along with 1/6th octave behavioral data in patients who were at risk for developing ototoxicity. Identification of clinically efficient, objective-monitoring techniques is essential in order to advance the field of ototoxicity monitoring. This could reduce significantly the number of patients who suffer disabling hearing loss that requires expensive and avoidable rehabilitation. A standard level of healthcare is the goal for all veterans at risk for ototoxicity to preserve their post-treatment quality of life.

Methods: Subjects included human patients who were scheduled to receive specified potentially ototoxic medications and control subjects. Prior to drug administration, behavioral audiometric thresholds were obtained to serve as the baseline audiogram that was used as the gold standard for hearing sensitivity measurement during the subject's enrollment. Two AEP and OAE techniques were also used to identify and monitor hearing in subjects receiving ototoxic medications and control subjects. Patients and controls were tested before drug treatment, during drug treatment, immediately post-treatment, and one-month post-treatment. A comparison was made between the changes in hearing sensitivity measured behaviorally with the changes in hearing sensitivity estimated by the AEP and OAE techniques.

Findings: Customized AEP and OAE instrumentation were developed for reliable estimation of auditory function at frequencies above 8kHz. Two OAE systems were evaluated and it was determined that the EMAN system had 10dB lower distortion. Two OAE methodologies were also evaluated (fine-structure and input-output function), and analysis techniques for each method were developed. Two AEP methods (single-toneburst and half-octave click train) were also evaluated for recording brainstem responses from 2 – 14kHz. The optimum transducer was chosen for the high-frequency AEP stimuli based upon maximal output above 8 kHz. After data collection, a custom AEP stimulus was adapted to optimize responses from listeners with cochlear hearing loss. The optimal AEP protocol consisted of half-octave click trains (one frequency, one intensity). The final study protocol for use with patients receiving ototoxic medication consisted of fine structure OAE and train-stimuli to elicit AEP. Four protocols were thus evaluated and two (one OAE and one ABR) were found suitable for clinical use. A continuation grant proposes to refine these two protocols further such that all patients, including those patients who are not able to provide reliable behavioral thresholds responses can be tested.

Title: Multi-Site Randomized Clinical Study of Tinnitus Treatment Methods

Principal Investigators: James A. Henry, PhD; Martin A. Schechter, PhD

Funding Agency: VA RR&D

Total Funding Received: \$682,729

Timeframe: 01/01/04 – 12/30/06

Objectives: Although tinnitus is especially problematic for veterans, the DVA has no established protocol for tinnitus rehabilitation. We recently completed a randomized clinical trial to evaluate the efficacy of tinnitus treatment for veterans. Tinnitus Masking (TM) and Tinnitus Retraining Therapy (TRT) were both shown to be effective for the majority of veterans treated with these methods by “expert” tinnitus clinicians. The objective of the present study is to determine if the same level of treatment efficacy observed in the previous study can be obtained by “typical” VA audiologists in their clinical environment. In addition, a third group has been added, called Audiologic Tinnitus Management (ATM), which will serve as a control group for nonspecific effects of treatment using a standardized protocol of hearing aids and education.

Plan: Veterans with clinically significant tinnitus were recruited to receive treatment with TM, TRT, or ATM in Audiology Clinics at the Bay Pines, Portland, San Diego, and Seattle VAMCs. There are three Treatment Audiologists at each of the sites, one for each of the three treatment methods. Each method uses a variation of “sound therapy” and of educational counseling. Sound therapy involves the use of wearable ear-level devices, including sound generators (“maskers”), hearing aids, or combination devices (hearing aid and masker combined). Only the ATM group is restricted to the use of hearing aids only (note: ATM subjects who do not require hearing aids are the only subjects in this study who do not receive ear-level devices). TRT uses a structured counseling protocol that teaches concepts that are unique to TRT. The TM protocol has been created to match the TRT counseling with respect to comparable formatting and length of counseling sessions, but containing information specific to the concepts of TM. The ATM counseling is similarly matched in format and length, but the information is more generic. Assessment of outcomes will utilize questionnaires that are administered at intervals before, during, and after the 18 months of treatment.

Methods: Potential participants at all sites were telephone-screened by the Project Audiologist in Portland to determine if the tinnitus is a problem sufficient to warrant 18 mo. of treatment. Veterans who passed the screening were scheduled to meet with the Research Coordinator (RC) at the respective study site. At this first visit, veterans completed informed consent and questionnaires, and were then informed of their group placement. Per a randomization schedule, they were placed into one of the three treatment groups, or into the 6-mo. waiting list group (with treatment starting 6 mo. later). At the initial evaluation with the respective Treatment Audiologist, a tinnitus verbal interview was administered, and hearing and tinnitus testing were performed. Custom ear-level devices were then ordered. Veterans returned 3-4 weeks later for device fitting and to receive the counseling/education that initiates treatment. Subjects return for follow-up treatment at 3, 6, 12 and 18 months. At the follow-up appointments, the RC collects and checks the questionnaires, and the Treatment Audiologist administers the follow-up verbal interview and repeats the counseling protocol. One year following treatment, the Project Audiologist will mail out written questionnaires that will be returned by mail, and will telephone the subjects to repeat the follow-up verbal interview.

Findings to date: The required number of subjects has been enrolled and is presently receiving treatment. There are no outcomes data to report at this time.

Title: Development of Clinical Instrumentation for Tinnitus Measurement

Principal Investigator: James A. Henry, PhD

Funding Agency: VA RR&D

Total Funding Received: \$554,129

Timeframe: 10/01/03 – 12/30/06

Objectives: Although tinnitus is a major problem for veterans and for the VA, most VAMCs do not have systematic clinical care available for their veterans suffering from tinnitus. Through continuous RR&D funding since 1995, we have developed a sophisticated computerized system for tinnitus quantification. The objective of the present study is to further develop the system to make it available for widespread application at VA audiology clinics.

Plan: To achieve the end goal, the tinnitus test system will be re-engineered and re-developed as a clinical piece of equipment. Following redevelopment and beta testing: reliability testing will be performed; a technique to test for “tinnitus malingering” will be developed; and the system will be evaluated in four VA audiology clinics.

Methods: Project 1 will consist mainly of technical development of the new automated system. System refinement will continue to the end of the study period. For Project 2, human testing will be conducted to evaluate test-retest reliability of responses to the various tests that the system will perform. Specific testing will be done to develop a tinnitus malingering test. With such a test, veterans with true tinnitus are expected to provide a characteristic profile of responses, while those feigning tinnitus would reveal a different profile. Two groups of veterans will be recruited from the Portland VAMC to complete this project: those with chronic tinnitus and those without tinnitus. For Project 3, the new system will be installed at four VAMC audiology clinics: Portland; Bay Pines, FL; San Diego, CA; and Biloxi, MS. The automated technique will be used to provide routine tinnitus assessment of veteran patients with the primary complaint of tinnitus. Project 3 is important to demonstrate that the system can be utilized in the clinical setting, and to obtain feedback from VA audiologists regarding the system’s performance.

Findings to date: The system has been developed and has been installed at the Bay Pines and San Diego VAMCs. Patients are presently being tested with the system at these two sites. Reliability testing is underway at the NCRAR. No data are yet available for analysis.

Title: The Effects of Diabetes on Processing of Verbal Communication

Principal Investigator: Nancy E. Vaughan, PhD

Co-Investigator: Dawn L. Konrad-Martin, PhD

Funding Agency: VA RR&D

Total Funding Received: \$768,000

Timeframe: 07/01/04 – 06/30/08

Objectives: The primary objective of this study is to determine whether diabetes related cognitive deficits are associated with greater difficulty understanding speech in adverse listening conditions for diabetic than non-diabetic patients.

Plan: The study is a follow-up study conducted by the VA National Center for Rehabilitative Auditory Research at the Portland VA Medical Center, in collaboration with Dept. of Public Health, Oregon Health Sciences University in Portland. The study is an observational two-group comparison study, designed to compare the diabetic and non-diabetic patients on a number of auditory and cognitive neural processing tasks and on two types of speech recognition tests.

Methods: Electrophysiologic, physiologic, and behavioral tests are conducted on two diagnostic groups of veterans – diabetic and non-diabetic. Electrophysiologic and physiologic tests will examine cochlear integrity (stimulus-frequency otoacoustic emissions), central brainstem conduction time (rate auditory brainstem studies), and speed of processing (cognitive P300 potentials). Behavioral tests will include clinical and experimental neuropsychological tests as well as speech recognition tests. Written questionnaires elicit data about the potential confounding variables such as coexisting medical conditions, noise exposure history, and health and disability status. Subjects also undergo special tests to detect and quantify peripheral neuropathy, and a small blood sample is drawn to check glycosylated hemoglobin (HbA1C test).

Findings to date: During the period January 1, 2005 through December 31, 2005, test protocols were refined and fifty-three patients were tested (with 27 diabetes and 26 without diabetes) for a total of 102 sessions including screening sessions. Three additional screening sessions were conducted which resulted in the exclusion of those patients because they did not meet audiometric criteria. All participants were recruited from lists of outpatients of the Portland VA Medical Center, Portland, OR. During this period, data entry forms were created for each set of test results, and a comprehensive database was developed for the entire data set. No data have been analyzed to this date, but the data from this extensive corpus of tests in addition to the clinical diabetes data is expected to provide insights into the effect of diabetes on verbal communication in this population.

Title: Investigation of Individualized OAE Techniques for Early Detection of Ototoxicity

Principal Investigator: Stephen A. Fausti, PhD

Participating Investigator: Dawn L. Konrad-Martin, PhD

Funding Agency: VA RR&D

Total Funding Received: \$746,900

Timeframe: 10/01/03 – 09/30/06

Objectives: The long-term goal of this research is to provide early detection and prevention of ototoxic hearing loss in veterans. The objective of this study is to determine the most reliable, sensitive and efficient *objective* technique for early detection of ototoxicity using otoacoustic emission (OAE) testing.

Plan: Distortion-product OAE (DPOAE) and stimulus-frequency OAE (SFOAE) test performance for detecting ototoxic hearing change is compared in this study. Individualized OAE data are collected in conjunction with behavioral threshold data in patients receiving ototoxic drugs at four study sites. Experimental subjects are inpatients and outpatients receiving selected ototoxic drugs. Control subjects are healthy individuals, and hospitalized patients not receiving ototoxic drugs.

Methods: To determine whether OAEs can reliably detect ototoxicity, an individualized distortion-product OAE (DPOAE) sensitive range for ototoxicity is defined as the highest one octave range of frequencies able to elicit reliable responses. Once this range is identified, intensity input/output (I/O) functions are analyzed as I/O functions represent basilar membrane compression rate characteristics, which are closely associated with cochlear outer hair cell function. We will first assess normal characteristics and test-retest differences of various OAE responses obtained in control subjects. This information will be used to determine which OAE parameters are likely to be reliable measures of the magnitude of ototoxic changes in cochlear function. The efficacy of these OAE responses as an ototoxicity-monitoring tool in subjects receiving ototoxic drugs is to be determined and optimized using clinical decision theory.

Findings to date: DPOAEs and SFOAEs were collected in the form of response growth functions, in which f_2 was held constant and L_2 varied in 5-dB steps. Test frequencies were varied from 1.0 to up to 10.0 kHz in one-third-octave intervals. Complete data sets were obtained in 40 healthy control subjects on two to three visits spanning one month's time. Valid DPOAEs could be recorded from all subjects. However, fewer responses were obtained at low L_2 and at the lowest and highest f_2 's tested, consistent with results in previous studies. Mean variability for DPOAE level change was typically about 3 dB for the range of f_2 's tested and was greatest at 6.3 kHz (3.71). Mean plus 2 SD at this f_2 was 7. Thus, changes in OAE response level for approximately 95% of subjects were no greater than 7 dB. SFOAEs were also obtained in ears of all control subjects. However, growth functions contained responses at fewer L_2 , largely because of the minimum amplitude criterion for SFOAE was -10 dB SPL compared to -20 dB SPL for DPOAE. There was very good agreement between SFOAE and DPOAE test-retest amplitude variability. These analyses were used to determine initial criteria for ototoxic change for a number of OAE variables. To date, 758 hospitalized patients have been screened for study inclusion; 62 patients (49 receiving ototoxic drugs and 13 receiving non-ototoxic drugs) are enrolled as study participants and each has completed up to 12 repeat test sessions. Preliminary analysis of data from these patients suggest the use of OAE level changes at a single stimulus level/frequency combination is less sensitive to early ototoxic insult compared with other OAE indicators that employ multiple stimulus level and/or frequency combinations.

Title: Ototoxicity Identification (OtoID) Device

Principal Investigator: Stephen A. Fausti, PhD

Funding Agency: VA RR&D

Total Funding Received: \$488,300

Timeframe: 07/01/04 – 12/31/07

Objectives: The primary objective of this rehabilitation engineering proposal is to develop our prototype unit into a user-friendly, portable, computer-automated audiometer-like device that performs individualized ototoxicity early monitoring using the evidence-based 1/6th octave sensitive range for ototoxicity (SRO) methodology.

Plan: The proposed project seeks to develop the prototype unit into a second-generation OtoID device. Key elements to successful completion of the OtoID project include: 1) hardware improvements to the prototype circuitry; 2) the development of custom-programmable SRO software applications to perform time-efficient and user-friendly ototoxicity early identification; 3) the development of PC-based data collection and reporting applications; and 4) field testing of the OtoID device in sound attenuation booths and hospital ward rooms at the Portland VAMC, in hospital ward rooms at distant site VAMCs, and in patients' homes.

Methods: The work proposed is divided into three phases: 1) prototype device upgrading; 2) software application development; and 3) data collection and reporting system. Phase I is focused on upgrading the hardware of the prototype device with support for computer-controlled output range switching, ambient noise measurement, performance verification support, non-volatile storage, and telephone communication. Phase II is focused on developing the OtoID automated software applications for ototoxicity testing. This work will commence once the engineer has completed development of the automated output ranging circuitry. Also, the engineer must complete the support for ambient noise measurement, performance verification and non-volatile storage so that extensive testing can be completed prior to the end of Quarter 6. In Phase III, we will concentrate on implementing the telemedicine-based data collection, reporting and sharing system, as well as extensive system reliability and sensitivity verification of onsite, remote site, and in-home test locations.

Findings to date: The current prototype consists of: 1) a handheld computer; 2) a prototype custom module; and 3) Sennheiser HDA200 headphones. The unit operates using a custom application that has been programmed to: 1) generate pulsed, stereo, pure-tone stimuli; 2) provide "pen-enabled, touch-pad" operated control of frequency selection, calibrated sound level selection, and muting functions; and 3) support on-screen recording and saving of hearing thresholds. The project team is nearing the end of Phase I hardware and firmware development and has some software applications from Phase II running on a portable, ready-to-be-used-for testing development unit. The project team has engineered a portable prototype suitable for performing ototoxicity early identification, while having stimulus quality equal to, or exceeding, most commercially available audiometers, and supporting frequencies out to 20kHz. The demonstration unit is totally portable with performance exceeding the early PocketPAL prototype device. Due to the obsolescence of the Ipaq 3650 PDA device which the early prototype was based upon, fairly extensive re-engineering of the hardware stimulus generation module was undertaken. This new design is not dependent on any particular manufacturer's PDA device and simplifies system deployment and useable lifetime. Feedback is being solicited from audiologists experienced in ototoxicity monitoring to improve the software applications.

Milestones: An invention disclosure for the prototype OtoID device was submitted to the VA, and the VA has asserted its ownership rights to the invention.

Other Federal Agency Submissions (n = 5; total requested funding = \$2,840,950)

Title: Temporal Resolution of Cochlear and Auditory Nerve Responses in Older Adults

Principal Investigator: Dawn L. Konrad-Martin, PhD

Funding Agency: NIH-NIDCD, RO3 (under review)

Total Requested Funding: \$189,000

Timeframe: Three years requested (pending outcome of scientific review; 04/01/06 – 03/31/09)

Objectives: Older adults have greater difficulty understanding speech compared with younger adults, even when hearing sensitivity is similar between the two groups. Impaired perception of time-varying speech cues may help explain these differences in speech understanding between elderly and young adults with similar audiograms. Temporal resolution is known to decline with age. However, this decline is due to an unknown mixture of peripheral (cochlear and auditory nerve), central auditory and cognitive processing deficits. The overall goal of this work is to determine the extent to which poor temporal resolution and specific physiological changes within the auditory periphery can account for age-related deficits in the processing of temporal aspects of speech. Once sources of reduced temporal processing are known, hearing aid fitting and rehabilitative training strategies can be devised that remediate temporal processing problems of individual patients. Proposed physiological measures are quick and unaffected by age-related changes in cognition or memory. These measures might, therefore, lead to development of clinical tools that target sources of reduced temporal processing within peripheral auditory processing stages.

Plan: Proposed experiments will measure physiological responses, modifying recently published psychophysical techniques used to assess temporal resolution and basilar membrane compression. These measures will then be compared to performance on temporal speech tasks in the same groups of elderly and young adults with normal or impaired hearing. Specifically, this study will (1) determine effects of age and hearing loss on temporal resolution at the level of the auditory nerve; (2) determine the extent to which age-related changes in the amplitude and timing of neural transmissions can be accounted for by changes in peripheral processes; and (3) characterize the dependence of voice onset time discrimination on temporal measurements at the levels of the cochlea and auditory nerve within the auditory systems of older adults.

Methods: A between-subjects research design, the performance of 4 groups totaling 120 subjects will participate in this study (2 groups of 40 elderly individuals and 2 groups of 40 young subjects). Elderly subjects will be at least 63 years old with normal hearing or cochlear hearing loss (high frequency pure-tone-average [HFPTA] = 30-50 dB HL). Young subjects will be 18 to 35 years old with normal hearing or with hearing loss (HFPTA = 30-50 dB HL). Procedures will include pure-tone audiometric assessment using conventional and ultra-high frequencies, physiological assessment (including tympanometry, electrophysiological recording of auditory nerve compound action potentials [CAPs], and stimulus-frequency otoacoustic emissions [SFOAE] testing), and psychophysical assessment of voice onset time identification and discrimination.

Findings to date: The funding period for this proposal has not yet begun. Thus, there are no findings to report at this time.

Title: A Joint DoD-VA Hearing Loss Prevention Program (HLPP)

Principal Investigators: Stephen A. Fausti, PhD; Dale A. Ostler, PhD

Funding Agency: DoD-VA Joint Initiative Fund

Total Requested Funding: \$851,950

Timeframe: Two years requested (reviewed – score not in fundable range; resubmitting in 2006)

Objectives: This project seeks to create a hearing loss prevention program that can provide high-quality hearing health care to soldiers and veterans. This project will also provide a seamless continuum of care and facilitate the sharing of medical records between the Departments of Defense (DoD) and Veterans Administration (VA). The project objectives are to create a multimedia Hearing Loss Prevention Program that can be delivered in a primary care or other medical setting, to create a seamless continuum of care between the DoD and the VA, and to demonstrate the feasibility of sharing hearing health care records between the DoD and the VA. More specifically we aim to: 1) Identify and address barriers to hearing loss prevention within the VA and DoD systems, as well as barriers to hearing health care experienced by individual soldiers and veterans; 2) Adapt an existing multimedia hearing loss prevention program to accommodate the needs of military personnel, as well as add capacity. The program will facilitate the education and awareness of military personnel and veterans regarding hearing loss and it will also allow the user to obtain more appropriate hearing protection and to use it more effectively, thus preventing future hearing loss; 3) Construct “Intelligent” Hearing Evaluation Booths; and 4) Create electronic information exchange to demonstrate the feasibility of record exchange between the VA and the DoD.

Plan: The study consists of four phases. In Phase I we will identify practice patterns for hearing conservation within the VA and DoD systems, as well as barriers to hearing health care experienced by individual soldiers and veterans. We will hold focus groups with soldiers and veterans, survey VA and DoD audiologists, and participate in the Department of Defense Hearing Conservation Working Group to identify and target systemic issues that may be involved in providing seamless, patient-centered care. In Phase II, we will modify the University of Michigan Hearing Loss Prevention Program to accommodate the needs of military personnel. We will modify the video portions, reprogram computer capabilities, and add the capacity for testing Hearing Protection Devices (HPDs) and for Web interface. In Phase III we will build two portable, computerized booths that will deliver the multimedia program, screen hearing, provide HPD use verification, and obtain clinical data. In Phase IV we will evaluate the current status of record exchange and address barriers to fluent electronic exchange of records.

Methods: To complete Phase I we will hold focus groups with soldiers and veterans, survey VA and DoD audiologists, and participate in the DoD Hearing Conservation Working Group to identify and target systemic issues that may be involved in providing seamless, patient-centered care. In Phase II we will work with a multimedia production team to complete the multimedia program, ultimately consist of four modules: 1) A self-administered hearing sensitivity screening test for conservation purposes and HPD use test; 2) A computerized questionnaire assessing knowledge, attitudes and behaviors concerning hearing loss; 3) A tailored interactive multimedia presentation aimed at changing knowledge, attitudes and intended behaviors in occupational and recreational settings; and 4) A module that provides participants with feedback about their hearing and with individually tailored advice on hearing health care, including use of HPDs. This phase will require evaluation of the system, confirmation that hearing screenings are valid and validation of the computerized questionnaire. In Phase III the intelligent booths will be built.

Findings to date: There are no findings to date as this proposal is not as yet funded.

Title: Improving Health Literacy Using a Tinnitus Education Model

Principal Investigator: James A. Henry, PhD

Funding Agency: NIH (under review)

Total Requested Funding: \$1,250,000

Timeframe: Five years requested (pending outcome of scientific review)

Objectives: The purpose of this study is to develop materials and methods for educating the low-health-literacy population about tinnitus. Because information about tinnitus is relatively unknown to the health community and to the general public, developing these materials for tinnitus education provides an appropriate model for evaluating a variety of educational formats for improving health literacy.

Plan: A three-site study will be conducted in two phases. The sites will include the Portland and James A. Haley (Tampa) VA Medical Centers, and the Cleveland Clinic. Each phase will involve a randomized clinical trial (RCT).

Methods: For Part 1, three types of low-health-literacy educational materials will be developed and professionally produced during Year 1: a booklet, an audio CD/cassette, and a multi-media DVD. The educational content will be the same for each of these three venues. During Years 2 and 3, an RCT will be conducted to evaluate the relative efficacy of each format. Individuals with chronic tinnitus will be recruited and randomized to receive one of the three formats. Questionnaires will be completed pre-intervention and 3 months post-intervention. The Tinnitus Handicap Inventory will be used to evaluate outcomes of treatment. Knowledge about tinnitus will be assessed using a tinnitus-information multiple-choice test that will be developed based on the common content of the three educational materials. The Salient Belief model will be used to assess attitudes and beliefs about tinnitus. Data analyses will focus on the lower one-third of patients based on results of literacy testing using the Rapid Evaluation of Adult Literacy in Medicine (REALM).

Part 2 will involve the second RCT that will be conducted during Years 4-5. Investigators at each of the three study sites will conduct group informational counseling sessions. Subjects will be recruited and randomized into one of two intervention groups: group counseling or utilization of the educational format that was the most effective during Part 1. Participants for Part 2 will include only those who rank in the lower one-third of results from the REALM. Questionnaires for Phase 2 will be done as for the questionnaires described for Part 1.

Findings to date: The study is pending review. There are therefore no findings to report.

Title: Otitis Media Impact on the Inner Ear

Principal Investigator: Dennis R. Trune, PhD

Funding Agency: NIH-NIDCD (under review)

Total Requested Funding: \$275,000

Timeframe: Two years requested (pending outcome of scientific review)

Objectives: The goal of this research is to identify how inflammatory processes in the middle ear cause cochlear dysfunction. The PI, in collaboration with colleagues, has recently developed an acute otitis media mouse model, as well as described chronic otitis media in the C3H/HeJ mouse that has a defect in its toll like receptor 4 (TLR4). Furthermore, these collaborations have led to the development of new methods to characterize both middle ear and inner ear cytokine expression, NF-kB-mediated inflammatory processes, nitric oxide-mediated cochlear damage, and quantitative immune cell pathology. The proposed studies will capitalize on both these acute and chronic middle ear disease mouse models to establish the correlative middle ear and inner ear immune mediated processes. This will describe for the first time the molecular immune mechanisms by which otitis media can directly cause inner ear pathology. Therefore, this research has the potential to significantly advance our understanding of inner ear inflammatory processes elicited by both acute and chronic otitis media and lay the groundwork for development of new procedures for the detection and therapy of such hearing loss.

Plan: The specific aims of this proposal are:

- Aim 1:* To characterize the inner ear inflammatory processes in acute otitis media. This will clarify immune-mediated processes in the cochlea elicited by short-term middle ear infections.
- Aim 2:* To characterize the inner ear inflammatory processes in chronic otitis media. This will clarify inner ear immune-mediated processes that can result from chronic middle ear infections.

Methods: The proposed studies will utilize BALB/c mice inoculated in the middle ear with heat-killed *Haemophilous influenza* or *Streptococcus pneumoniae* (acute otitis media) and C3H/HeJ mice defective for TLR4 (chronic otitis media) to characterize inner ear pathology, physiology, cytokine gene expression, cytokine levels, NF-kB activated inflammatory processes, and reactive oxygen species. Inner ear pathology will be measured with auditory brainstem response audiometry, the endocochlear potential, light and electron microscopy, and immunohistochemistry of inflammatory mediators. Cochlear immune-mediated processes will be assessed by measurement of inflammatory cytokines, cytokine gene expression, and ELISA of transcription factors, vascular related factors, and reactive oxygen species.

Expected findings: We anticipate that several inner ear cytokines will be upregulated by the middle ear disease. Preliminary Findings to date suggest that cytokines to both inflammatory processes and connective tissue remodeling will be increased. If the proposed studies support this, it would explain the basis for not only labyrinthitis, but also the laying down of connective tissue and bone in the inner ear following systemic infections.

Title: Limiting Inflammation in Bacterial Meningitis by Targeting Host Immune Pathways

Principal Investigator: Steven H. Hefeneider, PhD

Co-Investigator: Dennis R. Trune, PhD

Funding Agency: NIH-NIAID (pending approval)

Total Requested Funding: \$275,000

Timeframe: Two years requested (pending outcome of scientific review; 07/01/06 – 6/30/08)

Objectives: In bacterial meningitis, these inflammatory mediators cause the breakdown of the blood-brain barrier and formation of brain edema, leading to clinical disease development. Corticosteroids, given before or concomitantly with antibiotics, are the only anti-inflammatory therapy that have shown efficacy in humans. New treatment strategies that selectively target the host inflammatory innate immune response in bacterial meningitis are needed. We have recently identified and characterized a peptide, derived from the A52R vaccinia virus protein, that i) inhibits the in vitro production of pro-inflammatory cytokines and chemokines in response to a variety of TLR ligands, and ii) functions in vivo to significantly reduce bacterial-induced inflammation in a mouse model of middle ear inflammation. We propose in this study to test the feasibility of this peptide as a new treatment to reduce inflammation and limit disease development in bacterial meningitis.

Plan: This proposal addresses the hypothesis that use of a novel anti-inflammatory reagent, termed peptide P13, will inhibit production of inflammatory mediators initiated both by bacterial products and pro-inflammatory cytokines, and thereby reduce inflammation and limit disease development in bacterial meningitis. Initial in vitro experiments will establish the effectiveness of peptide P13 to inhibit inflammatory mediators produced by immune cells in response to heat-killed *S. pneumoniae* or IL-1. Following these studies, the effectiveness of peptide P13 to inhibit inflammation and thereby limit disease development will be examined using a murine in vivo model of *S. pneumoniae* induced meningitis. The specific aims are:

Aim 1: Determine in vitro the effectiveness of peptide P13 to inhibit induction of inflammatory mediators produced by host immune cells stimulated with *S. pneumoniae* or IL-1.

Aim 2: Determine the effectiveness of peptide P13 to limit inflammation and disease development in experimental pneumococcal meningitis.

Methods: The proposed studies will employ both in vitro and in vivo assessments of immune function to evaluate the potential therapeutic potential of peptide therapy in meningitis. The in vitro studies will utilize the following established cell lines: i) macrophages (RAW264.7), ii) endothelial cells (bEND.3), and iii) microglial cells (C8-B4), for assessment of inflammatory mediators produced in response to incubation with heat-killed *S. pneumoniae*. In vivo studies will use BALB/c mice (6-8 weeks of age and weighing 18-22 g) injected with 15 μ L of either PBS (negative control) or heat-killed *S. pneumoniae* (concentration range 10^5 , 10^7 , or 10^9 CFU/ml) into the cisterna magna. The mice will be treated with peptide and then assessed for inflammatory parameters and clinical evaluation of disease development.

Expected Findings: It is anticipated that viral infection of the brain will be easily established and we will be able to evaluate its control by using our anti-inflammatory peptide. Our data to date suggest that middle ear disease and systemic cytokine levels are controlled by the peptide. Therefore, we expect to be able to control brain cytokine levels elevated by the bacteria.

Other Federal Agency Approvals (n = 1; total funding received = \$825,000)

Title: Steroid Responsive Mechanisms in the Ear

Principal Investigator: Dennis R. Trune, PhD; Co-Investigator: Steven H. Hefeneider, PhD

Funding Agency: NIH-NIDCD, RO1

Total Funding Received: \$825,000

Timeframe: 09/01/05 – 08/31/08

Objectives: The long term goal of this research is to characterize the steroid driven cellular mechanisms of the ear. Preliminary studies have shown hearing loss in the MRL/MpJ-Faslpr autoimmune mouse responds to treatment with both the glucocorticoid prednisolone and the mineralocorticoid aldosterone. It is hypothesized that two steroid-responsive mechanisms exist in the ear: a *direct* sodium and potassium transport (homeostatic) gene expression mediated by the mineralocorticoid receptor, and an *indirect* inflammatory gene suppression mechanism mediated by the glucocorticoid receptor.

Plan: The planned studies will characterize these steroid-driven cellular and molecular processes with steroid treatments that will functionally isolate the receptors and measure changes in the cochlear homeostatic and inflammatory gene expression they control. The *specific aims* to investigate these steroid mechanisms of the ear are:

Aim 1: Determine the dose-dependent control of inner ear ion homeostatic and inflammatory gene expression by the mineralocorticoid aldosterone and the glucocorticoid prednisolone.

Aim 2: Determine the most effective control of both inner ear ion homeostatic and inflammatory gene expression processes by combination doses of the two steroids.

Aim 3: Determine which cochlear cellular and molecular functions are mediated by each steroid receptor.

Aim 4: Determine if effective inner ear homeostatic and anti-inflammatory gene expression can be induced by middle ear steroid delivery.

Methods: In all studies, assessment will be made of steroid effects on inner ear structure (light and electron microscopy), function (ABR, EP), cochlear specific antibodies (ELISA), and cochlear gene products (ELISA, cytokine RNA expression, and quantitative RT-PCR). The results from these studies will provide significant new findings regarding the cellular and molecular mechanisms of the ear that are under the control of steroids. This study also will lay important groundwork for the development of alternative steroid therapies that may be more effective than those currently employed for clinical hearing loss.

Findings to date: Combination steroid treatment with both the glucocorticoid and mineralocorticoid was effective at doses lower than the effective dose of either alone, suggesting an additive or interactive effect when they are combined. This suggests combination therapy may be feasible at doses low enough to avoid the severe side effects of glucocorticoids that currently prevent long term management. Treatment of mice with the commercially available mineralocorticoid fludrocortisone was as effective as the natural mineralocorticoid aldosterone in preventing hearing loss. Studies also indicate that the glucocorticoids given for inner ear disease may bind to the mineralocorticoid receptor to improve cochlear ion homeostasis and hearing. Also, the intratympanic delivery of steroids for hearing loss will get steroids into the inner ear quickly, but levels decline by 24 hours.

Milestones: Filed patent application for mineralocorticoid treatments for hearing loss.

Ongoing Other Federal Agency Funding (n = 5; total funding received = \$5,733,061)

Title: Hearing Loss and the Perception of Complex Sounds

Principal Investigator: Marjorie R. Leek, PhD

Funded by: NIH-NIDCD

Total Funding Received: \$938,780

Timeframe: 09/01/03 – 08/31/08

Objectives: Auditory speech recognition by individuals with hearing loss requires recovery of the intended message from a distorted internal representation of the input stimulus. This research is focused on the preservation of temporal precision in auditory processing by hearing-impaired listeners, and how these measures relate to pitch perception. The preservation of precise temporal firing patterns in the auditory nervous system is necessary for the clear perception of pitch that supports recognition of speech sounds as well as for the ability of normal-hearing people to extract the speech signal from a noisy background. An understanding of the interaction of factors such as impaired spectral and temporal processing with the acoustics of speech is critical to the potential ability to tailor programmable hearing aids to individual patients' hearing losses.

Plan: The experimental group will be people with sensorineural hearing loss and a control group will consist of subjects with normal hearing. The listeners will be asked to discriminate among sounds that vary along acoustic dimensions known to be important to auditory processing of speech and other sounds: the frequency spectrum, the temporal waveform envelope, and the temporal fine structure in the waveform. Experiments are also proposed that will estimate the amount of temporal "jitter" imposed by a damaged auditory system in the preservation of accurate neural temporal information across different frequency ranges.

Methods: Listeners will be asked to listen over earphones to specially constructed sounds and indicate their ability to discriminate them by touching designated areas on a touch-screen monitor or by pushing buttons on a response box. The sounds to be tested will vary depending on the exact experimental question that is being asked. For each set of sounds, a mean discrimination threshold and variability will be determined. In a second type of task, listeners will be asked to match the pitches of two types of complex sounds. For this task, the listener will hear two sounds alternating, and will be able to control the pitch of one of them until he/she estimates that they match. The frequency relationships of the matched sounds will be compared to findings in normal-hearing listeners, and the variability of the matches will indicate the stability and strength of the perceived pitch.

Findings to date: Some experiments were completed while Dr. Leek was still at Walter Reed Army Medical Center, including one that measured consonance and dissonance of both pure tones and complex tones in hearing-impaired listeners. Findings were that people with hearing loss showed less difference between those pairs of tones that were considered consonant and those that had a harsher or dissonant sound. This may result in music becoming distorted for these people, and also may contribute to the difficulties they experience in identifying and separating different voices. They also determined that hearing-impaired listeners were restricted in their ability to discriminate temporal waveforms with short durations. This means that some of the fine structure in speech waveforms may be indiscriminable to these people, which likely interferes with the ability to clearly understand speech. We also studied vowel perception by hearing impaired listeners. Although they could identify clear vowel tokens as well as normal-hearing people, their identification of vowels that are acoustically more similar to everyday speech sounds (i.e., not clearly articulated) showed a great deal of overlap across vowels.

Title: Health Communication: Noise-Induced Hearing Loss and Tinnitus

Principal Investigators: William H. Martin, PhD; Judith L. Sobel, PhD; Susan E. Griest, MPH

Funding Agency: NIDCD-Science Education Partnership Total Funding Received: \$984,260

Timeframe: 12/01/03 – 11/30/06

Objectives: To design, implement and evaluate intervention strategies applying current health communication and behavior theory to increase knowledge, change attitude and behavioral intention consistent with hearing loss prevention.

Plan: The target population will be 4th grade school students in Oregon and SW Washington. Four, single educational interventions will be compared to a non-intervention control group.

Methods: This three-phase project includes the development, delivery and evaluation of four educational interventions: 1) Phase 1 involves further development of the existing Dangerous Decibels™ Classroom program, development of an educator training program and a web-based version of the existing Dangerous Decibels™ exhibit; 2) During Phase II, interventions are presented to fourth grade students, and changes in their knowledge, attitudes and intended behaviors regarding NIHL and tinnitus prevention is measured and analyzed; and 3) Phase 3 involves the design of experiments using a paired-intervention approach to identify enhanced educational effectiveness in regards to changing knowledge, attitudes and intended behavior.

Findings to date: Preliminary results show that high school students and school nurses are equally effective at delivering the NIHL and tinnitus prevention classroom program to 4th grade students. All four intervention groups showed significant improvements from pre- to post-intervention ranked in order of effectiveness: 1) Classroom Presentation (Health Professional Educators, Older-Peer Educators); 2) Web-based Museum Experience; and 3) On-site Museum Experience. The control group showed no improvement from the time of pre to follow-up questionnaire strongly suggesting that the increases obtained by the intervention groups were due to the educational intervention. A significant drop in gains made by the intervention groups at post-intervention was revealed at the follow-up evaluation (approximately 3 months following the intervention). Despite this disappointing trend, significant improvements from pre-intervention still remained.

Regression from post to follow-up evaluation is well documented in the literature. Confirming this trend in our study highlights the importance of addressing this issue. Health communication research demonstrates that paired-interventions, especially in the form of a “booster” separated in time from the initial program, will be more effective in long-term retention than a single-intervention approach. During the 2005-2006 school year, a second evaluation is being conducted using paired combinations of the most effective educational interventions.

Intervention 1: Classroom Presentation by Older-Peer Educators. High school students will present a NIHL and tinnitus prevention program to 4th grade students *plus* one month later will visit a 12-component exhibition of noise-induced hearing loss and tinnitus prevention at the Oregon Museum of Science and Industry. *Intervention 2:* Classroom Presentation by Older-Peer Educators. High school students will present a NIHL and tinnitus prevention program to 4th grade students *plus* one month later will interact with a web-based version of the museum exhibit communicating information about noise-induced hearing loss and tinnitus prevention. *Non-Intervention:* 4th grade control groups (matched for age, gender, socio-economic and geographic factors) will receive pre- and follow-up evaluation questionnaires without receiving an educational intervention. Students will receive pre- and post-intervention and follow-up questionnaires.

Title: Research Training in Otolaryngology/Head & Neck Surgery

Principal Investigator: Mark A. Richardson, MD

Co-Investigator: Dennis R. Trune, PhD

Funding Agency: NIH-NIDCD

Total Funding Received: \$580,240

Timeframe: 07/01/03 – 06/30/08

Objectives: Our research training program has five components:

1. Otolaryngology resident training;
2. Pre-doctoral training for medical students;
3. Pre-doctoral training for basic science PhDs;
4. Post-doctoral training for basic science PhDs; and
5. Coordinated interaction between recipients of the training grant and the clinical and research divisions of the department.

Plan: The specific aim of this grant is to train senior level otolaryngology residents in research at OHSU. Furthermore, their training is juxtaposed with that of pre- and postdoctoral students for cross fertilization of ideas, techniques, experimental design and interdisciplinary problem solving. This will facilitate the entry of otolaryngology physicians and other young investigators into academic practice or research careers and increase the likelihood of successful extramural funding for their research activities. The time period is a two-year research training program between the fourth and fifth years of OTO/HNS residency. This will allow resident physicians to formulate appropriate research questions and develop longer-term interests. This shorter term between research and academic appointments will enhance resident competitiveness for professional positions. Additionally, the rapidly changing landscape of medicine may mean that a promising area of research may be less relevant in a span of 3-4 years. New developments in the field may also permit pursuit of questions not conceived early in residency training.

Methods: This training grant trains senior level Otolaryngology residents in research methodology, critical thinking and science over a two-year period. This time also is used to develop projects that can be submitted as K08 awards or for other extramural funding. Juxtaposing their training with other young investigators embarking on research careers stimulates questions related to clinical problems. Oversight by experienced mentors, successful in grant funding, improves the likelihood of eventual extramural support. Of critical importance is the mix of trainees present in the labs, thus the requested support for residents, PhD postdocs and predocs and medical students. The interaction of clinical scientists with basic investigators shapes the development of critical research questions and influences the future directions taken by pre- and postdoctoral candidates. The exposure and training of clinicians in the rigorous processes of an active research lab brings clarity and definition to their research questions, ultimately critical for their success.

Findings to date: Four Otolaryngology residents have been selected for the program of two years of research. To select these four candidates, ten applicants were interviewed. Approximately six medical students have been funded for summer research projects. Also, each year a postdoctoral fellow and a pre-doctoral student have been funded for salary. The selection committee, made up of members of the training grant, makes the decision of who gets funding for a year.

Title: Core Center

Principal Investigator: Peter G. Gillespie, PhD

Co-Investigator: Dennis R. Trune, PhD

Funding Agency: NIH-NIDCD

Total Funding Received: \$2,062,861

Timeframe: 04/01/03 – 03/31/08

Objectives: The major goals of this project are to centralize expertise on bioengineering, imaging, and mouse genetics in order to enhance presently funded research projects and stimulate collaborations between participating investigators.

Plan: The objectives are to be achieved through three Core research facilities:

1. Bioengineering will provide computer hardware and software support for measurement of hearing;
2. Imaging will centralize existing OHRC confocal and electron-microscopic imaging; and
3. Mouse Genetics will provide mouse husbandry and genotyping for transgenic and gene-targeting constructs.

Methods: The methods for subproject “Imaging” Core (D. Trune, PI) are to provide microscopy and histology services for project participants.

Findings to date: Thus far, the Imaging Core has trained or assisted research investigators or technical staff of approximately 20 laboratories. Considerable assistance has been provided for laser confocal microscopy, as well as preparation of cryostat sectioning of the ear for immunocytochemistry. New mouse models have been established for ion homeostasis disorders of the ear and these will be characterized in the coming months.

Title: Dangerous Decibels™: Partners in Public Health

Principal Investigators: Susan Holloway; Susan E. Griest, MPH; William H. Martin, PhD; Mary B. Meikle, PhD

Funding Agency: NIH-NIDCD

Total Funding Received: \$1,166,920

Timeframe: 09/29/00 – 09/28/05

Objectives: To significantly reduce the prevalence of preventable hearing loss and tinnitus.

Plan: A consortium of innovative researchers, museum educators, civic leaders and volunteers proposed a unique partnership to significantly reduce the incidence and prevalence of preventable noise-induced hearing loss and tinnitus, a growing problem among children and adults. To address this critical public health concern, a unique public/private partnership including the Oregon Museum of Science and Industry, the Oregon Hearing Research Center, the Veterans Affairs National Center for Rehabilitative Auditory Research, the American Tinnitus Association, and Oregon and Southwest Washington elementary and secondary schools.

Methods: The project was comprised of three freestanding, but interlocking components to create a strong public health campaign: 1) exhibitry; 2) curriculum; and 3) research.

Phase I: Development and full production of a 12-exhibit museum exhibition incorporating education, entertainment and pre-post knowledge evaluation; test-ready curriculum; and evaluation tools and hearing screening capabilities for data acquisition.

Phase II: Classroom presentations with hands-on, interactive activities and classroom program evaluation in six Oregon and Southwest Washington counties.

Phase III: Dissemination of regional model program and implementation strategy for hearing science education and hearing loss prevention. Classroom program and museum exhibit evaluation analysis. Research results regarding subject factors and noise-induced hearing loss in children.

Evaluation of the Dangerous Decibels® classroom program focused on effectiveness in changing knowledge, attitudes, and intended behaviors across diverse ethnic, socio-economic, and geographic populations. Seventy-five Oregon and SW Washington classrooms (grades 1, 4, and 7) received the program, completing pre-, post-, and follow-up questionnaires.

Findings to date: Results indicated the Dangerous Decibels™ classroom program significantly changed knowledge, attitudes, and intended behavior regarding hearing and hearing loss prevention strategies for 1st, 4th and 7th grade students. Fourth and seventh grade students (N=507) significantly improved across all knowledge items, ranging from a 10.2% to 51.8%, while items addressing attitudes showed improvements ranging from 13% to 23%. Intended behavior was measured by whether or not they would wear hearing protection while attending a loud concert. Prior to receiving the program, 15% of the 7th grade students said they would use hearing protection at a loud concert. Following the program, the percentage increased to 44%. All increases from baseline to post intervention were statistically significant at $p \leq .01$. The control group (N=521) showed no improvement from the time of baseline to follow-up questionnaire, strongly suggesting increases obtained by the study groups were due to the educational intervention. Long-term evaluation revealed a need to improve knowledge retention and incorporate strategies to improve long-term changes in attitudes and behaviors particularly for the older age groups. Preliminary findings were presented at the National Hearing Conservation Association Conference, Tucson, AZ, February 2005.

Private Industry and Non-Profit Funding (n = 5; total funding received = \$2,176,725)

Title: Auditory Modeling of Suprathreshold Distortion in Persons with Impaired Hearing

Principal Investigators: Brian E. Walden, PhD; Marjorie R. Leek, PhD; Kenneth W. Grant, PhD; W. Van Summers, PhD

Funding Agency: The Oticon Foundation

Total Funding Received: \$1,812,768

Timeframe: 12/01/05 – 11/30/08

Objectives: Although current hearing aids generally do an excellent job of compensating for the loss of sensitivity resulting from hearing impairment, they are quite limited in their ability to address suprathreshold forms of distortion. Greater use of amplification by persons with impaired hearing may depend upon the development of signal processing algorithms that restore more normal suprathreshold auditory function. The research proposed in this application is intended as a precursor to the development of effective “reverse engineering” approaches to restoring more normal suprathreshold auditory function in persons with impaired hearing; that is, signal processing strategies that alter incoming auditory signals in such a way that, after processing by the impaired auditory system, more normal neural input to the brain is achieved.

Plan: Although conceptually familiar to hearing aid software engineers, preprocessing of the incoming auditory input to compensate for distortions imposed by the impaired auditory system has not been feasible because of an inability to describe patient-specific distortions in a way that is amenable to familiar signal-processing approaches. This research seeks to take advantage of recent computer-based auditory processing models that provide visual and mathematical representations of auditory input at various stages of neural processing. The focus will be on the identification, verification, and prioritization of appropriate metrics of auditory function within individual hearing-impaired persons. Several measurements of auditory function will be taken on a small set of subjects in order to completely characterize their individual auditory systems, including measures of threshold, auditory frequency and temporal resolution, modulation perception, and auditory-visual integration ability. Measures will be used to parameterize auditory models in order to predict speech perception in noise and reverberation. The adequacy of these representations will be evaluated by determining if they are sufficient to predict certain behavioral measures of auditory and auditory-visual speech recognition in these patients.

Methods: Psychoacoustic (behavioral) tests will be carried out by listeners with various types and configurations of hearing loss. These will include tests of notched-noise masking, modulation perception, and speech recognition with speeded speech. In all experiments, listeners will be asked to listen over earphones to specially constructed sounds and indicate their ability to detect, discriminate, or identify them by touching designated areas on a touch-screen monitor or by pushing buttons on a response box. The sounds to be tested will vary depending on the exact experimental question that is being asked. As information becomes available about individual subjects, auditory models will be modified to attempt to predict the performance of that subject on evaluation studies of speech perception under noise and reverberation. The available computer models typically emphasize processing at different levels of the auditory ear-brain system, and the combination of the most successful of these models will lead to predictions of speech recognition performance for a given hearing impaired subject, that will be compared to actual measured performance. Successful predictions will suggest that important aspects of that listener’s suprathreshold processing have been captured in our modeling, and will lead to attempts to “work backwards” to try to develop more appropriate input speech to that person’s ear (i.e., that might be provided by a hearing aid signal processing algorithm).

Findings to date: This grant has just started and there are no findings to date.

Title: Improving Speech Perception in Noise in the FM + EM Condition

Principal Investigator: M. Samantha Lewis, PhD

Funding Agency: Phonak

Total Funding Received: \$15,372

Timeframe: 06/01/04 – 12/31/05

Objectives: The simultaneous use of an environmental microphone (EM) with an FM system can degrade speech perception in noise significantly over FM-only listening conditions. This listening condition, in which the FM and the EM are utilized simultaneously, is essential for the individual with hearing impairment to hear others in their immediate environment and to monitor his own voice, while listening to the individual utilizing the FM transmitter. Current ASHA recommendations regarding the fitting of FM technology suggest that the output of the signal from the FM transmitter should be 10 dB > the output from the EM in order to maintain the signal-to-noise advantages inherent in FM technology. At this time, no data is available regarding the optimum EM attenuation required for maximal speech perception in noise in the FM+EM mode. The purpose of this research investigation was to evaluate the effects of various EM attenuations on speech perception in noise in the FM + EM listening condition in two different listening situations using various FM/EM ratios (i.e., 0, -10, -20, -30, -40) when: 1) speech was presented to the FM transmitter (to represent the primary speaker); and 2) speech was presented to the EM of one of the hearing aids (to represent other speakers in the environment not utilizing the FM transmitter).

Plan: This investigation provided information regarding the optimum EM attenuation required for maximal speech perception in noise in the FM + EM mode in two different listening scenarios: 1) when speech is presented to the FM transmitter; and 2) when speech is presented to the EM of one of the hearing aids.

Methods: Reception thresholds for sentences (RTS) in noise were determined for subjects in two different listening conditions. These listening conditions will be: 1) binaural Phonak Claro 311 dAZ BTE hearing aids utilized with two Phonak Microlink FM receivers in the F +EM mode with speech being delivered from 0° azimuth; and 2) binaural Phonak Claro 311 dAZ BTE hearing aids utilized with two Phonak Microlink FM receivers in the FM+EM mode with speech being delivered from 90° azimuth. Uncorrelated speech spectrum shaped noise was presented from four loudspeakers positioned at 45°, 135°, 225°, and 315° azimuths in both listening conditions. Various EM attenuations were utilized in each listening condition to determine the optimum EM attenuation for maximal speech perception.

Findings: Statistical analyses revealed a significant main effect of listening condition, loudspeaker location, and a significant interaction between these two main effects. Specifically, there was a significant difference in RTS between the unaided listening conditions and all of the aided listening conditions at the various FM/EM ratios except for 40dB FM/EM. Additionally, there was a significant difference between RTS obtained from the two loudspeaker locations. An analysis across the six conditions for loudspeaker located at 0° azimuth revealed the following: 1) the RTS for the unaided condition was significantly different than all of the aided listening conditions; and 2) the RTS obtained at 0 dB FM/EM was significantly different from all of the other listening conditions except the RTS obtained at 10 dB FM/EM. For the loudspeaker located at 90° azimuth, there was a significant difference between the RTS obtained at 0 dB FM/EM and the RTS obtained at 20 dB FM/EM.

Title: An Evaluation of the Efficacy of the Beltone AVE as a Pre-fitting Counseling Tool

Principal Investigator: Gabrielle H. Saunders, PhD

Funding Agency: GN Resound North America Group

Total Funding Received: \$42,150

Timeframe: 03/01/04 – 02/28/05

Objectives: Research shows that unrealistic expectations about the benefits of hearing aids can impact user satisfaction, and that counseling aimed at altering expectations and other attitudes prior to fitting can improve outcome. In this study, a computerized hearing aid fitting and counseling tool (the Beltone AVE system) will be used to demonstrate to new hearing aids users how their hearing aids will sound in common listening situations before they leave the clinic in order to determine whether the AVE system can (a) be used to successfully alter expectations about hearing aids and (b) whether by doing so, individuals are more satisfied with their hearing aids than individuals who have not been exposed to the AVE system.

Plan: The study will yield answers to the following questions: 1) Does demonstration of “real world” listening with the Beltone AVE system impact pre-use expectations of new hearing aid users? 2) Do more realistic expectations of hearing aid outcome improve actual hearing aid outcome? 3) Does use of the ‘fine-tuning’ feature of the Beltone AVE system in conjunction with the real-world demonstration feature of the AVE improve outcome over use of the real-world demonstration feature alone?

Methods: Three groups of twenty subjects are being recruited for this study. All subjects have mild to moderate sensorineural hearing loss and are new hearing aid users. Subjects in each group are matched as closely as possible on audiometric configuration, age and pre-fitting expectations. Subjects in Group 1 receive counseling and demonstration of real world listening situations with the Beltone AVE fine-tuning system. They also have their hearing aids adjusted using the Beltone AVE protocol. Subjects in Group 2 also receive counseling and demonstration of real world listening situations with the Beltone AVE system but do not have their hearing aids adjusted with the system. Subjects in Group 3 receive hearing aid counseling that does not involve the AVE system. The content of the counseling provided to each group is similar, it is the mode of presentation that differs. All subjects undergo audiometric testing, evaluation of their ability to understand speech in noise and questionnaire assessment of expectations about hearing aids. Subjects are then fitted with a pair of behind-the-ear hearing aids and are counseled using the protocol associated with the group to which they are assigned. Following counseling, but prior to hearing aid use, they complete the expectations questionnaires a second time. Subjects then wear the hearing aids for six weeks after which hearing aid satisfaction and benefit are re-measured. Outcomes for each test group are compared.

Findings: To date 59 of the sixty subjects have been enrolled, of which 57 subjects have completed the protocol. Preliminary analyses show the groups to not differ in their pre-fitting expectations. Pre- to post-counseling expectations differ significantly across groups on some questionnaire scales such that the expectations of Group 1 and 2 subjects decreased while the expectations subjects in group 3 did not. Additionally there are marginally significant differences in the final satisfaction across groups on two of the hearing aid satisfaction scales.

Title: The Impact of Hearing Aid Microphone Polar Patterns on Sound Localization

Principal Investigators: M. Samantha Lewis, PhD, Gabrielle H. Saunders, PhD

Funding Agency: National Organization for Hearing Research Total Funding Received: \$15,000

Timeframe: 01/16/04 – 01/15/05

Objectives: Directional microphone technology has repeatedly been shown to improve speech intelligibility in noise. Directional microphones are effective because they have differential sensitivity around the hearing aid microphone, thus they amplify sounds coming from one direction to a greater extent than they do sounds coming from elsewhere. Despite their ability to improve speech intelligibility in noise, a potential disadvantage to hearing aids with directional microphones is that sound localization may be disrupted. Since the auditory system compares the differences in the intensity of signals arriving at the two ears to detect the origin of higher frequency signals (greater than 1500Hz), it would seem probable that a directional microphone that artificially alters the intensity of signals from certain angles would impact this.

Plan: The purpose of this study is two-fold. First, we will evaluate the sound localization ability of adults with bilateral, mild to moderate sensorineural hearing loss (SNHL) while wearing in-the-ear (ITE) hearing aids set to various hearing aid microphone polar patterns to determine whether or not sound localization is disrupted by directional microphones. Second, we will examine the trade-off between improved speech intelligibility in noise and diminished sound localization with directional hearing aids. The information obtained in this study will lead to a better understanding of the impact of directional microphone technology on localization which can be used by audiologists to better counsel their patients about situations that are/are not optimal for localization and speech intelligibility in noise. Additionally, if sound localization is negatively impacted by directional microphone technology, signal- processing algorithms could be developed to compensate for this disruption.

Methods: To achieve these goals, the sound localization and speech intelligibility in noise abilities of ten subjects will be assessed in each of the following five listening conditions: 1) unaided; 2) aided with binaural ITE hearing aids in the omnidirectional microphone mode; 3) aided with binaural ITE hearing aids in the cardioid microphone mode; 4) aided with binaural ITE hearing aids in the hypercardioid microphone mode; and 5) aided with binaural ITE hearing aids in the bi-directional microphone mode. Localization ability will be assessed with a computer-controlled test system. Subjects will be seated in the center of a circle of 24 loudspeakers, separated from each other by 15°. A short duration narrow-band noise will be presented from one loudspeaker at a time in a random order. The subject's task will be to locate the source of the signal and respond on a touch screen. Speech intelligibility in noise will be assessed with the Hearing In Noise Test (HINT) sentences using an adaptive procedure. The HINT sentences will be presented from a loudspeaker positioned at 0° azimuth. Uncorrelated speech spectrum shaped noise will be presented from four loudspeakers positioned at 45°, 135°, 225°, and 315° azimuths. Performance across conditions will be compared and the relationship between microphone polar pattern and speech-perception scores will be examined.

Findings: Hearing aid microphone polar patterns had a significant effect on speech perception in noise and on localization.

Title: Development and Evaluation of an Outcome Measure for Tinnitus

Principal Investigator: Mary B. Meikle, PhD

Co-Principal Investigator: James A. Henry, PhD

Funding Agency: Tinnitus Research Consortium

Total Funding Received: \$291,435

Timeframe: 07/01/04 – 06/30/07

Objectives: A new outcomes instrument for measurement of the severity and negative impact of tinnitus will be developed in a multi-site study conducted by the Oregon Health & Science University in conjunction with three other clinical sites located in Ohio, Florida and Oregon, respectively.

Plan: An Outcomes Working Group (consisting of the eight co-investigators, assisted by outcomes consultants with psychometric and biostatistical expertise and an Advisory Panel of tinnitus experts) will be set up to develop the self-report questionnaire. It will be designed for use in (1) assessing the severity and negative impact of tinnitus in affected individuals, and (2) use in evaluating treatment-related changes in tinnitus. Responses from 1200-1500 tinnitus patients (with tinnitus ranging in severity from mild to severe) will be studied at the various sites over the 3-year period.

Methods: Using a systematic development protocol, a prototype questionnaire will be developed during the first 6 months of Year 1. The prototype questionnaire will then be administered to all subjects at intake and to those requesting treatment (approximately half of the group) at 3, 6, and 9 months following the initiation of their treatment. The resulting data will be entered into a database for statistical evaluation. A variety of statistical techniques, including correlational and other factor-analytic techniques will be used to evaluate psychometric characteristics of the instrument (validity, reliability) and its responsiveness to change will be evaluated using a hierarchical linear model to test whether treated subjects show significant tinnitus improvement compared to wait-listed controls. Based on preliminary findings with the first prototype, in Years 2-3 a second prototype questionnaire will be developed and evaluated at the various sites, using similar statistical procedures. It is anticipated that the final product, the “Tinnitus Functional Index” or TFI, will exhibit desirable psychometric characteristics that are well-adapted to its various intended uses.

Findings to date: The phase 1 prototype instrument has been developed, and is currently being used at the different sites.

IV. CAPACITY BUILDING

Mentoring (Associate Investigators and Research Career Development Program Candidates)

Construction of a 21,000 square foot Center of Excellence facility is serving as a unique capacity building and mentoring advantage for attracting junior investigators and research career development candidates with new perspectives and stimulating ideas to generate hypothesis-driven rehabilitation research. The NCRAR facility is generously furnished with 9 dedicated auditory research sound attenuation rooms as well as an anechoic chamber and the latest clinical and research instrumentation as shared, core resources. The facility provides optimally functional space, and the center's diverse, yet complimentary, multidisciplinary team creates a unique mentoring advantage that is difficult, if not impossible, to accomplish otherwise. During 2005, the NCRAR was privileged to mentor the following individuals:

Associate Investigator Awardees

- Elizabeth Leigh, PhD, Audiology Post-doctoral Fellow (N. Vaughan, Mentor).
- M. Samantha Lewis, PhD, Audiology Post-doctoral Fellow (G. Saunders, Mentor).

Rehabilitation Research Disability Supplement Awardee

- Mitchel Turbin, PhD, Rehabilitation Research Psychologist (S. Fausti; G. Saunders; D. Storzbach; J. Henry; K. James, Mentors).

Research Career Development Awardee

- Dawn Konrad-Martin, PhD, Rehabilitation Research Audiologist (S. Fausti, Mentor).
- M. Samantha Lewis, PhD, Rehabilitation Research Audiologist (G. Saunders, Mentor).

Research Career Scientist Awardee

- James Henry, PhD, Rehabilitation Research Audiologist (S. Fausti, Mentor).

Senior Research Career Scientist Candidate

- Marjorie Leek, PhD, Rehabilitation Research Audiologist (S. Fausti, Mentor).

Otolaryngology Residents

- Bobby Ghaheri, MD, Otolaryngology Resident, Supervised Research Project (D. Trune, Mentor).
- Anna Grosz, MD, Otolaryngology Resident, Supervised Research Project (D. Trune, Mentor).
- Christopher Hargunani, MD, Otolaryngology Resident, Supervised Research Project (D. Trune, Mentor).

Post-doctoral Research Associates

- Jennifer B. Tufts, PhD, Postdoctoral Research Associate, Walter Reed Army Medical Center (M. Leek, Mentor).
- Michelle R. Molis, Ph.D., Postdoctoral Research Associate, Walter Reed Army Medical Center (M. Leek, Mentor).

Pre-doctoral Students

- Amanda M. Lauer, MA, PhD Candidate, University of Maryland, College Park, MD (M. Leek, Mentor).

- Peter Jacobs, MSEE, PhD Candidate, Oregon Graduate Institute, School of Science & Engineering, Oregon Health & Science University, Portland, OR (S. Fausti; E. Wan; D. Erdogmus, Mentors).
- Kristin Vasil, BA, AuD/PhD Candidate, University of Connecticut, Storrs, CT (M. Samantha Lewis, Mentor).

Master's Graduate Students

- David Cyrill, Graduate Thesis Project (P. Jacobs, Mentor)

Undergraduate Students

- Elizabeth Gordon, Pre-medical School Intern (D. Konrad-Martin, Mentor).
- Brianna Hoffman, Supervised Research Project (D. Trune; S. Hefeneider, Mentors).
- Jonathon Jungwirth, Supervised Research Project (D. Trune, Mentor).
- Eric Paugh, Electrical Engineering Intern (R. Ellingson, Mentor).
- Jordan Tabayoyon, Pre-medical School Intern (D. Konrad-Martin, Mentor).

Student Temporary Employee Program Students

- Hanna Chung, Research Student Intern (J. Henry, Mentor).
- Monica DeLong, Research Student Intern (J. Gordon; K. Reavis, Mentors).
- Kasia Hoss, Research Student Intern (D. McDermott, Mentor).
- Katie Kalk, Research Student Intern (D. Konrad-Martin, Mentor).
- Mark Lisowski, Research Student Intern (M. Samantha Lewis, Mentor).

NCRAR Staff

Administrative Division

- Bonnie Becker, *Administrative Special Assistant*, 100% Salaried VA.
- Dennis Bourdette, MD, *Associate Director*, 63% Salaried VA.
- Marcia Collins, *Program Support Assistant*, 100% Salaried VA.
- Stephen Fausti, PhD, *Director*, 100% Salaried VA.
- Patrick Helt, MA, *Administrative Officer*, 100% Salaried VA.
- Patricia Saub, *Budget Analyst*, 100% Salaried VA.
- Dennis Smith, MD, *Administrative Advisor*, 0% Salaried VA (Contract).

Research Division

- Donald Austin, MD, MPH, *Investigator*, 0% Salaried VA (IPA with academic affiliate).
- Nancy Bral, BS, *Research Coordinator*, 100% Salaried VA.
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- Gabrielle Saunders, PhD, *Investigator*, 100% Salaried VA.
- Daniel Storzbach, PhD, *Investigator*, 100% Salaried VA.
- Dennis Trune, PhD, *Investigator*, 0% Salaried VA (IPA with academic affiliate).
- Mitchel Turbin, PhD, *Investigator*, 100% Salaried VA.
- Nancy Vaughan, PhD, *Investigator*, 100% Salaried VA.
- Debbie Wilmington, PhD, *Investigator*, 100% Salaried VA.
- Tara Zaugg, MA, AuD Candidate, *Research Audiologist*, 100% Salaried VA.

Technology Design, Development and Support Division

- David Cyrill, Graduate Student, *Electrical Engineer*, 100% Salaried VA.
- Craig Dennis, *Computer & Network Support Technician*, 100% Salaried VA.
- Roger Ellingson, MSCSE, *Hardware/Software Engineer*, *100% Salaried PVARF.
- Joseph Istvan, PhD, *Biostatistician*, 0% Salaried VA (Contract).
- Peter Jacobs, MSEE, PhD Candidate, *Biomedical Engineer*, 63% Salaried VA.

- Kenneth James, PhD, *Biostatistician*, 0% Salaried VA (IPA with academic affiliate).
- Eric Paugh, BS Candidate, *Electrical Engineer*, 100% Salaried VA.
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Education and Information Dissemination Division

- Carolyn Landsverk, MS, *Education & Public Relations Coordinator*, 100% Salaried VA.
* (Retained via the Portland VA Research Foundation due to lack of competitive VA employment opportunities)

NCRAR Collaborators

- Judy Abrahamson, MA, *Collaborative Audiologist*, ** 100% Salaried VA.
- Harvey Abrams, PhD, *Collaborative Investigator*, ** 100% Salaried VA.
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- Scott Mader, MD, *Collaborative Investigator*, ** 100% Salaried VA.
- William Martin, PhD, *Collaborative Investigator*, ** 0% Salaried VA.
- Anthony McCall, MD, PhD, *Collaborative Investigator*, ** 0% Salaried VA.
- Mary Meikle, PhD, *Collaborative Investigator*, ** 0% Salaried VA.
- David Miller, PhD, *Collaborative Investigator*, ** 100% Salaried VA.
- Denis Moore, AuD, *Collaborative Investigator*, ** 100% Salaried VA.
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- Craig Newman, PhD, *Collaborative Investigator*, ** 0% Salaried VA.
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- Allen Ryan, PhD, *Collaborative Investigator*, ** 63% Salaried VA.
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- Ronald Schuchard, PhD, *Collaborative Investigator*, 100% Salaried VA.
- Barbara Sigford, MD, PhD, *Research Collaborator*, ** 100% Salaried VA.
- Helen Simon, PhD, *Research Consultant*, ** 0% Salaried VA.
- Terry Takahashi, PhD, *Collaborative Investigator*, ** 0% Salaried VA.
- W. Van Summers, PhD, *Collaborative Investigator*, ** 0% Salaried VA.
- Brian Walden, PhD, *Collaborative Investigator*, ** 0% Salaried VA.
- Eric Wan, PhD, *Collaborative Investigator*, ** 0% Salaried VA.
- Bevan Yueh, MD, *Collaborative Investigator*, ** 100% Salaried VA.

** (Did not receive salary support from the NCRAR)

NCRAR National Advisory Board

- Walter J. McDonald, MD, FACP, Executive Vice President, American College of Physicians – American Society of Internal Medicine (ACP – ASIM), Chairman.
- Leslie M. Burger, MD, FACP, Major General (Ret), US Army, Director (Ret), VISN 20, Member.
- David W. Chandler, COL, MS, Director, Executive Agencies, Office of The Surgeon General, Member.
- John D. Durrant, PhD, Professor, Department of Communication Science & Disorders and Otolaryngology, Director of Audiology, University of Pittsburgh Medical Center, School of Health and Rehabilitation Sciences, Member.
- Cynthia G. Fowler, PhD, Professor, Department of Communicative Disorders, University of Wisconsin, Member.
- James F. Jerger, PhD, Distinguished Scholar-in-Residence, University of Texas at Dallas, Member.
- Douglas Ohlin, PhD, US Army Center for Health Promotion and Preventive Medicine, Member.
- Donald E. Morgan, PhD, President, Hearing Resource Group Inc., Member.
- Allen F. Ryan, PhD, Professor of Surgery/Otolaryngology and Neuroscience, Director of Research, University of California at San Diego, School of Medicine, Division of Otolaryngology, Department of Surgery, Member.
- Leonard P. Rybak, MD, PhD, Professor, Department of Surgery, Division of Otolaryngology, Southern Illinois University, School of Medicine, Member.

- Jerome D. Schein, PhD, Professor Emeritus of Sensory Rehabilitation and Director, Deafness Research and Training Center, New York University, Member.

NCRAR Local Advisory Council

- Lesley M. Hallick, PhD, Provost and Vice President of Academic Affairs, Oregon Health & Sciences University, Member.
- G. J. (Jerry) Schleining, Department Service Officer, American Legion, Member.
- Michael P. Davey, MD, PhD, Associate Chief of Staff, Research Service, Portland VAMC, Member.
- John W. Kendall, MD, Academic Affiliation Liaison, VISN 20, Professor, Department of Medicine and Dean Emeritus, Division of Endocrinology, Diabetes and Clinical Nutrition, Oregon Health & Science University, Member.
- James A. Tuchschildt, MD, MM, Director, Portland VAMC, Member.

V. INFORMATION DISSEMINATION

The NCRAR serves as a national resource for hearing impaired veterans, their families, the community at large, and rehabilitation research and health care professionals. NCRAR rehabilitation researchers actively influence their fields by contributing to the integration of evidence-based research findings into clinical practice through the VA health care delivery system and the nation. In so doing, the NCRAR and its staff serve as VA ambassadors within their institutions and their professional organizations, effectively advancing the VA and the RR&D Service in the rehabilitation and scientific communities and national consciousness. Accordingly, the NCRAR effectively disseminated the following information:

Publications in the Journal of Rehabilitation Research and Development (JRR&D) (n = 6)

- Allen JB, Jeng PS, Levitt H. Evaluation of human middle ear function via an acoustic power assessment. *J Rehabil Res Dev.* 2005;42(4):63-77.
- Fausti SA, Wilmington DJ, Helt PV, Helt WJ, Konrad-Martin D. Hearing health and care – the need for improved hearing loss prevention and hearing conservation practices. *J Rehabil Res Dev.* 2005;42(4):45-61.
- Gordon JS, Phillips DS, Helt WJ, Konrad-Martin D, Fausti SA. Evaluation of the use of insert earphones for bedside ototoxicity monitoring. *J Rehabil Res Dev.* 2005;42:353-362.
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Publications in Press, Under Review, or in Preparation for the JRR&D (n = 7)

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- Henry JA, Rheinsburg B, Owens KK, Ellingson RM. Tinnitus malingering. J Rehabil Res Dev. In preparation, 2005.
- Henry JA, Rheinsburg B, Ellingson RM. Computer-automated tinnitus assessment: noise-band matching, maskability and residual inhibition. J Rehabil Res Dev. In preparation, 2005.
- Henry JA, Schechter MA, Loovis, C, Zaugg TL, Kaelin, C, Montero, M. Assessment of tinnitus severity using the Tinnitus-Impact Screening Interview. J Rehabil Res Dev. Under review, 2005.
- Lewis MS, Lilly DJ, Hutter MM, Bourdette DN, Saunders J, Storzbach D, Fausti SA. Some effects of multiple sclerosis on speech perception in noise: Preliminary findings. J Rehabil Res Dev. In press, 2005.
- Lilly DJ, Hutter MM, Lewis MS, Levitt H, Kusumoto A, Fausti SA. Development of a sound-field system and materials for the measurement of speech intelligibility in multi-talker babble. J Rehabil Res Dev. In preparation, 2005.
- Mullen LM, Fausti SA, Ryan AF. Biological strategies for improvement of auditory rehabilitation via a cochlear implant. J Rehabil Res Dev. In preparation, 2005.

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- Chandler DW, Grantham DW, Leek, MR. Effects of uncertainty on auditory spatial resolution in the horizontal plane. Acta Acust. 2005;91:513-525.
- Dreisbach LE, Leek MR, Lentz JJ. Growth of spectral contrast in harmonic complexes in normal-hearing and hearing-impaired listeners. J Speech Lang Hear Res. 2005;48:910-921.
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- Saunders GH, Fausti SA. Advanced hearing aid features: Directional microphones and telecoils. In: Saunders GH, Fausti SA, guest editors. Proceedings from the National Center for Rehabilitative Auditory Research (NCRAR) conference – Auditory rehabilitation: A multidisciplinary approach. *Semin Hear*. 2005;26(2):57-124.
- Saunders GH, Fausti SA. Plasticity, outcome measures, and evidence-based practice. In: Saunders GH, Fausti SA, guest editors. Proceedings from the National Center for Rehabilitative Auditory Research (NCRAR) conference – Auditory rehabilitation: A multidisciplinary approach. *Semin Hear*. 2005;26(3):125-189.
- Saunders GH, Cienkowski KM, Forsline A, Fausti SA. Normative data for the Attitudes towards Loss of Hearing Questionnaire. *J Am Acad Audiol*. 2005;16:637-652.
- Tufts JB, Molis MR, Leek MR. Perception of dissonance by people with normal hearing and sensorineural hearing loss. *J Acoust Soc Am*. 2005;118:955-967.
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- Barkhuizen A, Lim L, Trune D, Rosenbaum JT. Eye, Aural, and Oral Manifestations. Dubois' Lupus Erythematosus. 7th Edition. In: Wallace D, Hahn B, editors. William & Wilkins, Baltimore. In press, 2005.
- Fausti SA, Helt WJ, Gordon JS, Reavis KM, Phillips DS, Konrad-Martin D. Audiologic Monitoring for Ototoxicity and Patient Management, In: Campbell KC, editor. Pharmacology and Ototoxicity for Audiologists. In press, 2005.
- Fong KJ, Woo RJ, Trune DR. Effect of estrogen on olfactory neuron proliferation. *Am J Rhinol*. Accepted, revision in preparation, 2005.
- Ghaheri B, Kempton JB, Pillers DM, Trune DR. Cochlear gene array analysis of murine acute and chronic otitis media. *Laryngoscope*. Accepted, revision in preparation, 2005.
- Gordon JS, Konrad-Martin D, Phillips DS, Helt WJ, Reavis KM, Fausti SA. Hearing loss in adult cancer patients receiving cisplatin chemotherapy with and without radiation. *Ear Hear*. In preparation, 2005.
- Gubbels S, Bascom D, Trune, DR, Richardson, MA, Wax, MK. Tracheal reconstruction using porcine small intestine submucosa in a rabbit model. *Otolaryngol Head Neck Surg*. In press, 2005.

- Hargunani CA, DeGagne JM, Kempton JB, Trune DR. Inner ear uptake and distribution of dexamethasone injected into the middle ear. *Otol Neurotol*. In press, 2005.
- Hefeneider, S.H., McCoy, S.L., Tsung, A. A new treatment approach for LPS-induced inflammation and tissue damage. In preparation, 2005.
- Henry JA, Trune DR, Robb MJA, Jastreboff PJ. Neural and learning principles of tinnitus retraining therapy. *J Am Acad Audiol*. Accepted, revision in preparation, 2005.
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- Henry JA, Schechter MA, Zaugg TL, Griest S, Jastreboff PJ, Vernon JA, Kaelin C, Meikle MB, Lyons KS, Stewart BJ. Clinical trial to compare tinnitus masking and tinnitus retraining therapy. *Acta Otolaryngol Suppl*. Under review, 2005.
- Konrad-Martin D, Phillips DS, Henry JA, Helt WJ, Gordon JS, Reavis KM, Fausti SA. Ototoxic changes in tinnitus, hearing loss and otoacoustic emissions: Results of a large prospective study. *Ear Hear*. In preparation, 2005.
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- Lauer AM, Dooling RJ, Leek MR, Lentz JJ. Phase effects in masking by harmonic complexes in birds. *J Acoust Soc Am*. In press, 2005.
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- Lewis MS, Gordon J, Crandell C, Lilly D, Fausti SA. Improving speech perception in noise in the FM + EM listening condition. In preparation.
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- Lewis MS, Saunders G, Gordon J, Kusumoto A, Jacobs P, Fausti SA. The impact of hearing aid microphone polar patterns on speech perception in noise. In preparation, 2005.
- Lewis MS, Hutter M., Lilly D, Bourdette D, Saunders J, Fausti SA. Frequency modulation (FM) technology as a method for improving speech perception in noise for patients with multiple sclerosis. *J Am Acad Audiol*. Under review, 2005.

- MacArthur CJ, Hefeneider SH, Kempton B, Parrish SK, McCoy S, Trune DR. Evaluation of the mouse model for acute otitis media. *Hear Res.* Under review, 2005.
- MacArthur CJ, Kempton B, Trune DR. C3H/HeJ mouse model for spontaneous chronic otitis media. *Laryngoscope.* Under review, 2005.
- Mullen L, Pak K, Chavez E, Kondo K, Ryan AF. Ras/P38 and PI3K/Akt, but not Mek/Erk, signaling mediate BDNF-induced neurite formation on neonatal cochlear spiral ganglion explants. *Eur J Neurosci.* Under review, 2005.
- Reavis KM, Phillips DS, Fausti SA, Helt WJ, Gordon JS, Bratt GW, Konrad-Martin D. Relationship between ototoxic-induced changes in hearing thresholds and distortion-product otoacoustic emissions. *Ear Hear.* In preparation, 2005.
- Ryan AF. Our Evolving View of Cochlear Function. In Robinette M, Glatcke T, editors. *Otoacoustic Emissions*, 3rd Ed., Thieme, New York, NY. In press, 2005.
- Ryan AF, Wittig J, Evans A, Dazert S, Mullen L. Environmental micropatterning for the study of spiral ganglion neurite guidance. *Audiol NeurOtol.* In press, 2005.
- Saunders GH, Forsline A. The Performance-Perceptual Test (PPT) and its relationship to aided reported handicap and hearing aid satisfaction. *Ear Hear.* In press, 2005.
- Saunders GH, Forsline A, Jacobs P. Attitudes toward Loss of Hearing Questionnaire (ALHQ): A comparison of electronic and paper formats. *Am J Audiol.* Under review, 2005.
- Saunders GH, Lewis MS, Wilmington D. The impact of aging and hearing loss on sound localization ability. In preparation, 2005.
- Shiley SG, Trune DR, Fong KJ. Effect of estrogen on olfactory neuron connections to the olfactory bulb. *Am J Rhinol.* Accepted, revision in preparation, 2005.
- Trune DR, Kempton JB, Gross ND. Mineralocorticoid receptor mediates glucocorticoid treatment effects in the autoimmune mouse ear. *Hear Res.* In press, 2005.
- Trune DR. Role of mineralocorticoid receptor in glucocorticoid-responsive hearing loss. In: Lim DJ, editor. *Proceedings of the 5th International Symposium on Meniere's Disease and Inner Ear Homeostasis Disorders.* In press, 2005.
- Trune DR, Kempton JB, Ren T. Decreased endocochlear potential in MRL/MpJ-*Fas^{lpr}* autoimmune mice. *Hear Res.* Accepted, revision in preparation, 2005.
- Trune DR, Kempton JB, Larrain B, Harrison AR, Wobig JL. Assessment of systemic side effects of glucocorticoid treatments for autoimmune inner ear disease. *Hear Res.* Accepted, revision in preparation, 2005.
- Trune DR. Ion Homeostasis and Inner Ear Diseases. In: Hamid MA, Sismanis A, editors. *Medical Otology and Neurotology. A Medical Guide to Auditory and Vestibular Disorders.* Thieme, New York. In press, 2005.
- Vaughan N, James K, McDermott D, Griest S, Fausti SA. Five-year prospective study of diabetes and hearing loss in a veteran population. *J Otol Neurotol.* In press, 2005.
- Vaughan N, Storzbach D, Furukawa I. Sequencing and non-sequencing working memory in understanding of rapid speech by older listeners. *J Am Acad Audiol.* In press, 2005.
- Xie JJ, Pak K, Evans A, Fausti SA, Mullen LM, Ryan AF. Growth of spiral ganglion neurites in 3-D scaffolds, and in response to fibrocytes transfected with neurotrophic factors. In preparation, 2005.

Presentations at Scientific and Professional Conferences, Meetings, and Symposia (n = 45)

- Brittan-Powell E, Lauer A, Callahan J, Dooling R, Leek M, Gleich O. The effect of sweep direction on avian auditory brainstem responses. Acoustical Society of America, Vancouver, BC, Canada, June 2005.
- Cienkowski KM, Saunders GH. An evaluation of counseling strategies implemented by audiologists. Paper presented at the Academy of Rehabilitative Audiology Institute, Salt Lake City, UT, September 30th – October 2nd 2005.
- Dunkley KT, Konrad-Martin D, Leigh-Paffenroth LD, Mitchell CM, Fausti SA. Detecting ototoxicity in humans with high frequency DPOAEs. Podium presentation at the annual meeting of the American Auditory Society, Scottsdale, AZ, 2005.
- Gleich O, Leek MR, Dooling RJ. Cochlear excitation and synchronized across-frequency neural response: Modeling the neural response to Schroeder-phase harmonic complexes in several species. Association for Research in Otolaryngology, New Orleans, LA, February 2005.
- Griest SE. Can a Museum Exhibit Effectively Communicate the Hearing Conservation Message? Presented at the 30th Annual Meeting of the National Hearing Conservation Association, Tucson, AZ, February 2005.
- Griest SE. Dangerous Decibels® Program in 4th and 7th Grade Classrooms: Are They Getting the Message? Presented at the 30th Annual Meeting of the National Hearing Conservation Association, Tucson, AZ, February 2005.
- Handlesman J, Konrad-Martin D. Monitoring ototoxic changes in the auditory and vestibular systems. ASHA Division 6 sponsored Short Course presented at the American Speech-Language-Hearing Association, San Diego, CA, 2005.
- Henry JA. Guidelines for clinical management of tinnitus. Invited one-day seminar at the Nevada Speech-Language-Hearing Association Convention; University of Nevada, Reno, March 12, 2005.
- Henry JA. Clinical assessment of the tinnitus patient. Invited instructional course at the Missouri Speech-Language-Hearing Association 46th Annual Meeting & Convention; Tan-Tar-A Resort, Osage Beach, Missouri, April 9, 2005.
- Henry JA. Providing treatment with tinnitus retraining therapy. Invited instructional course at the Missouri Speech-Language-Hearing Association 46th Annual Meeting & Convention; Tan-Tar-A Resort, Osage Beach, Missouri, April 10, 2005.
- Henry JA. Clinical assessment of the tinnitus patient. Invited instructional course at the Connecticut Speech-Language-Hearing Association Spring 2005 Conference; Central Connecticut State University, New Britain, CT, May 5, 2005.
- Henry JA. Providing treatment with tinnitus retraining therapy. Invited instructional course at the Connecticut Speech-Language-Hearing Association Spring 2005 Conference; Central Connecticut State University, New Britain, CT, May 6, 2005.
- Henry JA, Schechter MA, Zaugg TL, Griest S, Jastreboff PJ, Vernon JA, Kaelin C, Meikle MB, Lyons KS, Stewart BJ. Clinical trial to compare tinnitus masking and tinnitus retraining therapy. Podium presentation at the VIIIth International Tinnitus Seminar, Pau, France, September 7, 2005.

- Henry JA, Rheinsburg B, Owens KK, Ellingson RM. New instrumentation for automated tinnitus psychoacoustic assessment. Podium presentation at the VIIIth International Tinnitus Seminar, Pau, France, September 8, 2005.
- Henry JA, Loovis C, Montero M, Kaelin C, Anselmi KA, Coombs R, Hensley J, James K. Randomized clinical trial: group counseling based on tinnitus retraining therapy. Podium presentation at the VIIIth International Tinnitus Seminar, Pau, France, September 8, 2005.
- Hefeneider S, Kurtz S, McCoy S, MacArthur C, Trune D. A new treatment strategy for otitis media with effusion. Presentation at the Association for Research in Otolaryngology, New Orleans, LA, February 2005.
- John A, Crandell C, Kreisman B, Kreisman N, Valente M, Lewis MS. Predicting self-reported hearing handicap using the HINT. Paper presented at the New Zealand Audiological Society Conference, Christchurch, New Zealand, June 2005.
- Konrad-Martin D, Phillips DS, Reavis KM, Gordon JS, Bratt GW, Fausti SA. A comparison of distortion-product and stimulus-frequency otoacoustic emissions for monitoring ototoxicity-induced hearing loss. Presented at the Midwinter Meeting of the Association for Research in Otolaryngology, New Orleans, LA, February 2005.
- Lauer AM, Molis MR, Leek MR Discrimination of temporal fine structure by listeners with sensorineural hearing loss. Association for Research in Otolaryngology, New Orleans, LA, February 2005.
- Leek MR, Molis MR, Kubli LR, Tufts JB, Cord MT. Enjoyment of music by elderly hearing-impaired listeners. American Auditory Society, Scottsdale, AZ, March 2005.
- Leek MR, Molis MR, Lentz JJ. Perception of combined intensity and frequency contours by normal-hearing and hearing-impaired listeners. Acoustical Society of America, Vancouver, BC, Canada, June 2005.
- Leigh-Paffenroth ED, Dunckley KT, Mitchell CM, Fausti SA. Detecting ototoxicity in humans with high frequency narrowband ABRs. Podium presentation at the American Auditory Society Annual Conference, Scottsdale, AZ, March 2005.
- Lewis MS, Hutter M, Lilly D, Bourdette D, Wilson R, Fausti SA. Some effects of multiple sclerosis on masking level differences. Poster presented at the American Speech-Language-Hearing Association Meeting, San Diego, CA, November 2005.
- Lewis MS, Crandell C. Frequency modulation (FM) technology applications. Instructional course presented at the 17th Annual American Academy of Audiology Convention, Washington, DC, April 2005.
- Lewis MS, Saunders G, Gordon J, Kusumoto A, Jacobs P, Fausti SA. The impact of hearing aid microphone polar patterns on speech perception in noise. Paper presented at the American Auditory Society Annual Meeting, Phoenix, AZ, March 2005.
- Lewis MS, Lilly D, Hutter M, Bourdette D, Fitzpatrick M, Fausti SA. Dichotic listening and multiple sclerosis. Poster presented at the American Auditory Society Annual Meeting, Phoenix, AZ, March 2005.
- Lilly DJ, Hutter MM, Lewis MS, Saunders J, Bourdette DN, Fausti SA. Release from masking in patients with multiple sclerosis. Poster presentation at the annual midwinter meeting of the Association for Research in Otolaryngology, New Orleans, LA, February 2005.

- Lilly DJ. Psychoacoustics, dead regions and hearing aids. Invited presentation to the 33rd Annual Tri-State Hearing Convention, Portland, OR, February 2005.
- MacArthur CJ, Hefeneider S, Parrish S, Kempton B, Trune D. Development of the C3H/HeJ mouse model for the study of spontaneous chronic otitis media and its impact on the inner ear. Association for Research in Otolaryngology, New Orleans, February 2005.
- Marks R, Lewis MS. Evidenced based medicine: evaluating scientific literature. Instructional course to be presented at the 17th Annual American Academy of Audiology Convention, Washington, DC, April 2005.
- Martin, WH, Griest SE, Howarth L. Having fun fighting dangerous decibels. Workshop presented at the 30th Annual Meeting of the National Hearing Conservation Association Tucson, AZ, February 2005.
- Martin WH, Griest SE, Shi Y-B. Automated NIHL and tinnitus screening in a museum setting. Presentation at the 30th Annual Meeting of the National Hearing Conservation Association, Tucson, February, 2005.
- Meikle MB, Abrams HB, Newman CW, Sandridge SA, Henry JA. Empirical development of a new tinnitus outcome measure. Podium presentation at the American Auditory Society Scientific and Technology Meeting, Scottsdale, AZ, March 20-22, 2005.
- Mullen LM, Ryan AF. A biological interface for the cochlear prosthesis. Conference on cochlear implants. Monterey, CA, August 2005.
- Pillers D, Kempton B, Trune D. Auditory electrophysiology of the *mdx*^{Cv3} and dy/dy mice show abnormal latencies which may provide evidence for one basis of cognitive defects found in Duchenne muscular dystrophy. Association for Research in Otolaryngology, New Orleans, February 2005.
- Ryan AF. Damage and replacement of cells in the inner ear. Genes, hearing and deafness: from molecular biology to clinical practice. European Network on Genetic Deafness. Caserta, Italy, March 2005.
- Ryan AF. The molecular basis of inner ear disease: from DNA sequence to future treatments. European Federation of Otolaryngology Societies. Venice, Italy, July 2005.
- Saunders GH, Forsline A. The Performance-Perceptual Test (PPT): Its relationship to unaided and aided hearing ability, and its use as a hearing aid counseling tool. Paper presented at the Academy of Rehabilitative Audiology Institute, Salt Lake City UT September 30th – October 2nd 2005.
- Schairer KS, Konrad-Martin D. Update on the use of stimulus-frequency otoacoustic emissions to investigate cochlear function. ASHA Division 6 sponsored Instructional Course presented at the Annual Convention of the American Speech-Language and Hearing Association, San Diego, CA, 2005.
- Trune DR. Role of mineralocorticoid receptor in glucocorticoid-responsive hearing loss. Presented at 5th International Symposium of Meniere's Disease & Inner Ear Homeostasis Disorders, Los Angeles, CA. April 2-5, 2005.
- Trune DR, Kempton B, Larrain B. Systemic side effects of glucocorticoid treatments for hearing loss. Presented at International Symposium: Pharmacologic Strategies for Prevention and Treatment of Hearing Loss and Tinnitus. Niagara Falls, Canada, October 9-12, 2005.

Trune DR, Kempton B, Parrish S, Hefeneider S. Glucocorticoids restore autoimmune hearing loss through the mineralocorticoid receptor. Association for Research in Otolaryngology, New Orleans, February 2005.

Zaugg TL, Griest S, Schechter MA, Henry JA. Change in tinnitus severity vs. change in tinnitus loudness (ratings and matches). Podium presentation at the VIIIth International Tinnitus Seminar, Pau, France, September 8, 2005.

Zaugg TL, Griest S, Schechter MA, Henry JA. Patient report of trouble tolerating sound vs. tonal LDLs in tinnitus patients. Podium presentation at the VIIIth International Tinnitus Seminar, Pau, France, September 7, 2005.

Zaugg TL, Kaelin C, Henry JA, Stewart BJ. Essentials of randomized clinical trials for tinnitus treatment methods. Podium presentation at the VIIIth International Tinnitus Seminar, Pau, France, September 9, 2005.

Sponsored Conferences and Workshops

The NCRAR hosted over 200 guests from 32 states, Israel, New Zealand, and Canada, for its second biennial international conference ‘The Aging Auditory System: Considerations for Rehabilitation’, September 22-23, 2005. The conference was held at the Portland World Trade Center and the Portland Waterfront Marriott Hotel and opened with a proclamation from Portland Mayor Tom Potter declaring September 22-23, 2005 ‘*Rehabilitative Auditory Research Days*’ in Portland. Margaret Giannini, MD, Director, Office on Disability, US Department of Health and Human Services (HHS), presented opening remarks.

The conference brought together clinical researchers and practicing audiologists in a highly interactive format with the goal of translating research findings into practice. Eight internationally respected researchers addressed four topic areas:

- Pathophysiology of the Aging Auditory System
- Behavioral Studies of Auditory Aging
- Cognitive Components to Auditory Aging
- Amplification and Beyond: Issues Associated with Treating the Geriatric Patient

Presenters were well-known experts in the field of auditory research: James Jerger, PhD (University of Texas at Dallas), Sandra Gordon-Salant, PhD (University of Maryland at College Park), John H. Mills, PhD (Medical University of South Carolina), Kathleen Pichora-Fuller, PhD (University of Toronto), Pam Souza, PhD (University of Washington), Therese Walden, AuD (Walter Reed Medical Center), Arthur Wingfield, PhD (Brandeis University), and Moe Bergman, Emeritus Professor, Tel-Aviv University. The conference format was highly interactive, with formal presentations followed by case studies presented by clinical audiologists and roundtable discussions with a panel of experts taking questions from the floor.

The NCRAR also sponsored a pre-conference workshop titled ‘Ototoxicity: Early Identification and Monitoring’ at the Portland VA Medical Center on September 21, 2005. This workshop was attended by 50 audiologists from across the country. Members of the NCRAR staff presented evidence-based protocols developed at the NCRAR for early identification and monitoring of ototoxic-induced hearing loss.

Both the conference and pre-conference workshop were accredited by the American Speech-Language and Hearing Association (ASHA) and the American Academy of Audiology (AAA). An opening reception included officers of the Veteran Service Organizations and representatives

from the offices of Oregon's U.S. Congressional delegation. VA audiologists and other professionals attending the conference indicated a high degree of satisfaction as measured by post-conference evaluation forms. Participants valued the interactive format and felt that what they learned would impact and improve the quality and cost-effectiveness of auditory rehabilitation services.

VI. CLINICAL INTERFACE

The NCRAR sponsors clinical research seminars presented by both invited scientists and NCRAR staff. These presentations are attended by NCRAR staff and staff from the Portland VAMC and other area hospitals and universities. The NCRAR also sponsors a series of informal clinical research roundtables where researchers present and discuss their research programs and findings. In addition, NCRAR hosts distance-learning opportunities through the American Speech-Language-Hearing Association (ASHA), providing an opportunity for audiologists at Portland VAMC and Oregon Health & Science University to obtain required ASHA continuing education credits.

Roundtables

Konrad-Martin DM. Ototoxicity early identification and monitoring; central auditory processing disorder; opportunities for implementation of protocols to ensure appropriate remediation of patients. VA Medical Center, Portland, OR.

Ghaheri B, Trune DR. Cochlear ion homeostasis and related hearing disorders. Grand Rounds, Department of Otolaryngology, Oregon Health & Science University, Portland, January 24, 2005.

Trune DR. Steroid Effects on the Inner Ear. Grand Rounds, Department of Otolaryngology, Oregon Health & Science University, Portland, April 11, 2005.

MacArthur CJ, Kempton B, Trune DR. C3H/HeJ Mouse Model for Spontaneous Chronic Otitis Media. Oregon Academy of Otolaryngology, Portland, November 11, 2005.

Seminars

Sweetow R. Beyond amplification: The need for listening and communication enhancement (LACE). Robert Sweetow, PhD, Director of Audiology, Professor of Otolaryngology, University of California, San Francisco, CA. Presentation at the NCRAR on November 9, 2005.

Olson A. Telephone options for deaf and hearing impaired listeners. Andrea Olson, MS, Cap Tel, Portland, OR. Presentation at the NCRAR on June 6, 2005.

Leek MR. Auditory temporal processing by hearing-impaired listeners. Marjorie R. Leek, PhD, Senior Research Audiologist, Army Audiology & Speech Center, Walter Reed Army Medical Center, Washington, DC. Presentation at the NCRAR on April 11, 2005.

Molis MR. Modeling vowel perception by hearing-impaired listeners. Michelle R. Molis, PhD, Research Associate, Army Audiology & Speech Center, Walter Reed Army Medical Center, Washington, DC. Presentation at the NCRAR on April 11, 2005.

Franklin A. The Otologics middle ear transducer: (Met) – an implantable hearing aid. Alan Franklin, MS, Otologics, LLC, Boulder, CO. Presentation at the NCRAR on April 13, 2005.

Turbin M. Counseling hard of hearing and late deafened persons: Issues and strategies. Presentation at Western Oregon University, Monmouth, OR on June 30, 2005.

Turbin M. How to talk with a person who has a hearing loss. Mitchel Turbin, PhD, NCRAR Investigator, Portland, OR. Presentation at the NCRAR on May 12, 2005.

Workshops

Ghaheri B, Trune DR. Cochlear gene analysis of murine acute and chronic otitis media. Oregon Academy of Otolaryngology, Portland, OR, November 11, 2005.

Gilmer-Knight K. Ototoxicity monitoring in children. Podium presentation at the NCRAR Pre-Conference Workshop: Ototoxicity early identification and monitoring. VA Medical Center, Portland, OR, September 21, 2005.

Gordon JS. Establishing a hospital ototoxicity monitoring program. Podium presentation at the NCRAR Pre-Conference Workshop: Ototoxicity early identification and monitoring. VA Medical Center, Portland, OR, September 21, 2005.

Henry JA. Guidelines for clinical management of tinnitus. Invited one-day training workshop for VA Audiologists at the Michael E. DeBakey VA Medical Center; Houston, TX, January 25, 2005.

Henry JA. Monitoring for ototoxicity-induced tinnitus. Podium presentation at the NCRAR Pre-Conference Workshop: Ototoxicity early identification and monitoring. VA Medical Center, Portland, OR, September 21, 2005.

Konrad-Martin D. Ototoxicity monitoring using objective measures of auditory function. Podium presentation at the NCRAR Pre-Conference Workshop: Ototoxicity early identification and monitoring. VA Medical Center, Portland, OR, September 21, 2005.

Konrad-Martin D, Fausti SA. Basic principles of ototoxicity monitoring. Podium presentation at the NCRAR Pre-Conference Workshop: Ototoxicity early identification and monitoring. VA Medical Center, Portland, OR, September 21, 2005.

Konrad-Martin D. Transient-evoked stimulus-frequency and distortion-product otoacoustic emissions: Effects of level and hearing status.” Invited lecture at San Diego State University, Department of Speech and Hearing Sciences, San Diego, CA, 2005.

Reavis KM. Ototoxicity monitoring in adults. Podium presentation at the NCRAR Pre-Conference Workshop: Ototoxicity early identification and monitoring. VA Medical Center, Portland, OR, September 21, 2005.

Trune DR. New approaches to treatment of middle ear disease. Department of Otolaryngology, Tripler Army Medical Center, Honolulu, HI, Dec 2, 2005.

Community Health Fairs/Lectures

January 2005

The NCRAR participated in a *Hearing Health Fair* hosted by the Lowestin Chapter of Self Help for the Hard of Hearing on January 11, 2005. This event was held in the Lake Oswego, Oregon Adult Community Center and attracted over 150 participants.

February 2005

NCRAR investigator Mitchel Turbin, PhD presented “The Emotional Impact of Hearing Loss” on February 8, 2005, at the Lowestin Chapter of Self Help for the Hard of Hearing. Following the presentation, which included a videotape showing ways to cope with challenging listening environments, Dr. Turbin facilitated a discussion in which audience members, most with hearing

loss, discussed difficulties they face in communicating, coping strategies and the importance of self-advocacy.

April 2005

NCRAR investigator James Henry, PhD presented “Tinnitus Clinical Research at the VA” on April 4, 2005, at the Casey Eye Institute, Oregon Health & Science University, Portland, OR.

NCRAR investigator Gabrielle Saunders, PhD was chosen to present her work at the *Portland VAMC 2005 Research Day* on April 8, 2005. Dr. Saunders spoke on new measuring methods designed to help increase user satisfaction with hearing aids. The Research Day lecture was open to the public and was attended by approximately 250 guests, including staff, patients, officers of Veterans Service Organizations, and staff from the offices of Oregon’s US Congressional Delegation.

NCRAR investigator David Lilly, PhD presented “Assessing Hearing Impairment – Beyond the Audiogram” on April 19, 2005 at the Portland Chapter of Self Help for the Hard of Hearing, Portland, OR.

NCRAR investigator Mitchel Turbin, PhD presented “Counseling Hard of Hearing and Late Deafened Persons: Issues and Strategies” on April 28-29, 2005 at Western Oregon University, Rehabilitation Counselor Education Division, Department of Special Education, Monmouth, OR.

May 2005

NCRAR investigator Mitchel Turbin, PhD presented a lecture for veterans and their families, medical center staff, and the general public on “How to Talk with a Person who has a Hearing Loss” on May 12, 2005, VAMC Portland, OR.

NCRAR displayed its exhibition poster in observation of *May Better Speech and Hearing Month* on May 24-26, 2005. The exhibit included the NCRAR exhibition poster, a variety of hearing conservation materials, including ear protectors, patient education materials on hearing aids, hearing loss, and how to provide an optimal listening environment for individuals with hearing loss, Portland, OR.

June 2005

NCRAR provided an educational display on hearing loss and hearing conservation for *Cancer Survivors Day*, June 9, 2005 in the Portland VAMC auditorium. This event was attended by over 300 veterans and their families.

August 2005

NCRAR director Stephen Fausti, PhD was interviewed on August 2, 2005, by area radio station KINK on the incidence and type of hearing loss sustained by troops in Iraq. The interview was broadcast on August 18, 2005, Portland, OR.

October 2005

NCRAR participated in a *Health Career Fair* for area high school students on October 12, 2005, an event which aimed at introducing young people to the many and varied opportunities to work in the field of health care. This event was held in the Portland VAMC Auditorium, and was attended by an estimated 250 high school students and their teachers.

November 2005

NCRAR investigator James Henry, PhD presented “Treatment of Tinnitus by Audiologists” on November 1, 2005 at the NCRAR/Audiology & Speech Pathology Service, Tinnitus Education Group, VA Medical Center, Portland, OR.

NCRAR/Portland VAMC Audiology Clinic Tinnitus Education Group Meetings

The NCRAR and Portland VAMC Audiology Clinic work jointly to provide support/education group meetings for veterans with tinnitus. Five meetings were conducted during 2005, and were facilitated by Drs. James Henry and Martin Schechter. Frequently there is a guest speaker, and attendance at the group varies up to 35 veterans per meeting. The mission of the group is to provide information that would be most helpful to veterans in managing their own tinnitus.

Expositions and Conventions

NCRAR disseminated information on recent publications, upcoming conferences, and technology development to thousands of attendees at two large professional conventions, the American Academy of Audiology (AAA) Convention, March 29- April 3, 2005, in Washington, DC, and the American Speech-Language and Hearing (ASHA) Convention, November 17-20, in San Diego, California. Attendance at the AAA 2005 Convention was 6,747 and the ASHA Convention had over 10,000 participants.

NCRAR Website

The NCRAR website, www.ncrar.org serves as a valuable means of communication and dissemination of information for professionals and the community. The website features a quarterly newsletter, calendar of events, publications and presentations, staff bios, abstracts of funded research programs and projects, professional links, employment opportunities, and information on NCRAR sponsored conferences and seminars. During August through October, 2005, the website averaged 2162 unique visitors per day. During the month of September, 2005 the website received 34,002 hits.

Dangerous Decibels Exhibit

The “Dangerous Decibels” exhibit at the Oregon Museum of Science and Industry (OMSI) opened June 4, 2002. This interactive display, designed to educate both children and adults, is a collaborative effort involving the OMSI, Oregon Health & Science University – Oregon Hearing Research Center, American Tinnitus Association, and the NCRAR. The goal of the exhibit is to increase public awareness of noise-induced hearing loss and tinnitus, and teach strategies to protect against hazardous noise exposure. The exhibit will remain on display at the OMSI until 2010.

Technology Development and Transfer

NCRAR rehabilitation researcher-scientists and rehabilitation engineers have designed and developed several innovative technologies and evidence-based methods that are useful in the assessment and treatment of various facets of auditory function and dysfunction. Staff of the NCRAR strive to combine evidence-based research findings with emerging technologies to optimize the effectiveness and efficiency of hearing health care delivery using computer-automation and tele-medicine principles. The following are representative examples of the NCRAR’s technology development and transfer efforts:

Multimedia program for a VA Hearing Loss Prevention Program (HLPP): The NCRAR is in the midst of developing a multimedia program for a HLPP to be aimed at veterans. The program is being developed by CraftMaster, a professional creative production company in conjunction with three members of the NCRAR. The program under development is an instructional multimedia presentation that emphasizes prevention and behavior change as the key to minimizing further hearing loss among veterans. The multimedia program consists of an introductory video explaining why prevention of hearing loss is important and which describes the content of the remainder of the program. The remainder of the educational part of the program consists of four sections which cover why prevention of hearing loss is important, how hearing can be protected, when protection is necessary and how the ear works. Each of these sections has a video module and an interactive module. The interactive modules permit the participant to tailor the program to his/her personal needs and lifestyle. Finally participants can test their own hearing using a self-administered screening hearing test via calibrated headphones. On completion of the program participants will each receive an informational print out and the results of their hearing test.

The presentation is currently being designed for use in a stand-alone kiosk but will be designed so that it can be adapted for use over the internet. Once the multimedia program has been completed a merit review proposal will be developed and submitted for funding with the goal of evaluating the efficacy of the intervention program.

AudioTest Software: NCRAR engineering staff designed, developed and completed version 1.0 of AudioTest software. AudioTest is a custom software application developed in Visual C#/C++ designed to enable researchers to develop their own sound localization and questionnaire tests involving complex calibrated audio stimuli. The software is similar to other off-the-shelf psychoacoustics testing software such as E-Prime, Presentation and MediaLab with the important distinction that in AudioTest there is significantly more control given to the researcher as they configure the location and level of audio stimuli presented to the patient during a psychoacoustic test. The software is currently being used by two investigators (Saunders and Vaughan) within their research studies. It is expected to be applied to other projects at NCRAR and is listed within upcoming grant proposal submissions (Turbin, Konrad-Martin).

AnalyzeOAE Software: NCRAR engineering staff designed and developed a software application called AnalyzeOAE written in Matlab. The program performs signal processing and feature extraction including amplitude and latency measures on otoacoustic emission waveforms collected using NCRAR's OAE measurement system. The software has been instrumental in a number of research projects at NCRAR (Vaughan, Konrad-Martin) and in acquiring pilot data for future studies.

High-frequency Otoacoustic Emissions (OAE) Measurement System: We have developed a high-frequency otoacoustic emissions (OAE) data acquisition and measurement system that runs custom software developed by Stephen Neely at the Boystown National Research Hospital, in Omaha, NE. Our system utilizes a custom "buffer" amplifier or headphone buffer to match the impedance difference between the soundcard used to generate the stimulus and the headphones used to present the stimulus. The Maxim 4299 IC headphone amplifier evaluation board was modified and encased, isolating the right and left stimulus channels to prevent crosstalk and electrical inter-modulation distortion. Few commercial high-frequency OAE measurement systems exist. The distortion, signal-noise ratio, and frequency response of our system were found to be better than commercial OAE systems.

Method and Device for Non-invasive Analyte Measurement: NCRAR engineering and auditory researcher staff and a collaborator from the Oregon Graduate Institute have developed a new means to non-invasively measure an analyte in blood using masked otoacoustic emissions. We have discovered that OAEs recorded during both masked and unmasked conditions correlate with blood glucose levels. The invention we are in the process of disclosing describes a device that a patient or clinician may use to non-invasively monitor their analyte levels by taking recordings of OAEs evoked under masked and unmasked conditions.

Directional Microphone Test System: NCRAR engineering staff designed and developed a system that is being used to test the functionality of directional microphones in hearing aids. The system consists of a computer, a Card Deluxe sound card, a B&K Controllable Turntable 5960 + Controller (5997), KEMAR, SoundCheck 5.0 software, Dirac 3.0 software, and custom VBA scripts written in Microsoft Excel. The system is capable of generating polar plots for directional microphones within hearing aids and also for measuring reverb of a room. Technical staff wrote a user manual, and the system is currently being used by Dr. Saunders for a research study comparing the functionality of various directional microphone hearing aid systems.

Ototoxicity Early Identification and Monitoring Methods: NCRAR rehabilitation researchers have developed an evidence-based protocol for early identification and monitoring of ototoxic hearing change using proven behavioral methods and emerging objective methods. Our behavioral method has been shown to be time efficient, sensitive and reliable. This year our protocol has been accepted for publication in a book chapter on pharmacology for Audiology AuD students. We believe this is the first book of its kind, and as such, it should enjoy wide readership among audiology students. Our protocol has also been accepted for publication in the Volta Review, a preeminent scholarly research and scientific journal in the field of hearing loss, and as a series of clinical briefs in publications of the American Speech-Language-Hearing Association (ASHA). Portions of the ototoxicity monitoring protocol were presented at three recent clinical conferences, at the Annual Conferences of the American Auditory Society and the American Speech-Language-Hearing Association, and at the 2005 NCRAR Pre-Conference Workshop.

Ototoxicity Identification (OtoID) Device: NCRAR engineering staff have combined pure digital audio technology with a pocket PC platform to create a completely portable, battery operated device that enables individualized ototoxicity early identification with a high degree of efficiency, reliability, sensitivity, and specificity (VA asserted ownership rights January 2004). As part of an ongoing RR&D Rehabilitation Engineering proposal, working prototype handheld and base units have been developed and are being tested by a Research Audiologist to acquire baseline hearing configurations.

Computer Automated Tinnitus Psychoacoustic Testing System: NCRAR rehabilitation researchers and engineers have developed and are in the process of re-engineering a sophisticated, computer-automated system for tinnitus quantification. The system is currently installed and beta testing is being conducted at the Bay Pines, FL and San Diego, CA VAMC audiology clinics, and soon will be installed and performed at the Biloxi, MS and Portland, OR VAMC audiology clinics as well. Reliability testing is currently underway at the NCRAR (VA and OHSU Invention Disclosures submitted December 2005).

Programmable Audio Laboratory (PAL3000): NCRAR engineering staff developed a custom hardware system that serves as a platform for a specialized audiometer capable of obtaining reliable measures of hearing thresholds in 1/6th octave intervals for early identification of noise-

and ototoxic-induced hearing loss, as well as tinnitus pitch and tinnitus loudness levels (VA asserted ownership rights January 2004).

VII. RESEARCH COLLABORATIONS

The NCRAR continuously seeks to expand its network of mutually beneficial collaborative partnerships with other federal agencies, VA and non-VA research and medical centers, academic institutions, private industry organizations and non-profit foundations with complementary rehabilitation research and development foci. The center's multidisciplinary consortium of professionals actively engage in rehabilitation research collaborations and clinical trials with other clinicians and researchers including audiologists, auditory physiologists, endocrinologists, epidemiologists, immunologists, neurologists, neuropsychologists, oncologists, otolaryngologists, public-health specialists, and speech language pathologists. The NCRAR has successfully developed the following mutually beneficial research and clinical trial collaborations:

Project Title: A Biological Interface for Rehabilitation with a Cochlear Implant

Specific Objectives: To improve the cochlear implant performance by combining device engineering and biological approaches to produce a biological interface between the implant and the tissues of the inner ear, thereby decreasing the distance between the electrodes and cochlear neurons so that more channels of information can be delivered.

Agencies and Institutions Involved: NCRAR, Portland VAMC, Portland, OR; San Diego VAMC, San Diego, CA; University of California at San Diego, San Diego, CA.

Participating Investigators: Allen Ryan, PhD; Stephen Fausti, PhD.

Project Title: A Joint VA/DoD Hearing Loss Prevention Program

Specific Objectives: The project objectives are to create a multimedia Hearing Loss Prevention Program that can be delivered within the DOD hearing conservation programs and in primary care or other medical settings in the VA and DOD health care systems, and to encourage a seamless continuum of care between the DoD and the VA.

Agencies and Institutions Involved: NCRAR, VAMC, Portland, OR; Madigan Army Hospital, Ft. Lewis Military Reservation, Tacoma, WA; Walter Reed Army Medical Center, Washington, DC; House Ear Institute, Los Angeles, CA; Sensimetrics Corporation, Somerville, MA.

Participating Investigators: Marjorie Leek, PhD; Stephen Fausti, PhD; Dale Ostler, PhD; Gabrielle Saunders, PhD; Douglas Ohlin, PhD; Sigfrid Soli, PhD; Susan Griest, MPH; Dennis Smith, MD, Patrick Zurek, PhD; Michael Cook, LTC, MS.

Project Title: A Method for Improving Localization Abilities in Individuals with Auditory and Visual Impairment

Specific Objectives: The objective of this study is to investigate the interactions between hearing loss and aging upon sound localization ability.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; Center for Aging with Vision Loss (CAVL), VAMC Decatur, Atlanta, GA.

Participating Investigators: Gabrielle Saunders, PhD; Ronald Schuchard, PhD; Stephen Fausti, PhD; Harry Levitt, PhD.

Project Title: A Test to Measure the Impacts of Dual-Sensory Impairment on Daily Function

Specific Objectives: This study seeks to document the difficulties encountered in daily living by individuals with dual sensory impairment (DSI), and then to use this information to develop a measure to quantify the effects of DSI upon activities of daily living.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; Center for Aging with Vision Loss (CAVL), VAMC Atlanta, GA.

Participating Investigators: Gabrielle Saunders, PhD; Nancy Vaughan, PhD; Katharina Echt, PhD.

Project Title: Auditory Modeling of Suprathreshold Distortion in Persons with Impaired Hearing

Specific Objectives: To parameterize a set of computer auditory models to fully characterize individual listener's peripheral and central auditory systems in order to predict speech perception.

Agencies and Institutions Involved: Army Audiology & Speech Center, Walter Reed Army Medical Center, Washington, DC; Oticon Foundation, Copenhagen, Denmark (funding agency); NCRAR, VAMC Portland, OR.

Participating Investigators: Brian Walden, PhD; Marjorie Leek, PhD; Kenneth Grant, PhD; W. Van Summers, PhD.

Project Title: Dangerous Decibels: A Statewide Hearing Conservation Program

Specific Objectives: This unique public/private partnership seeks to significantly reduce the incidence and prevalence of preventable noise-induced hearing loss, a growing problem among children and adults.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; Oregon Hearing Research Center Tinnitus Program, Oregon Health & Science University, Portland, OR; Oregon Museum of Science & Industry, Portland, OR; American Tinnitus Association, Portland, OR.

Participating Investigators: William Martin, PhD; Susan Holloway; Gloria Reich, PhD; Mary Meikle, PhD; Susan Griest, MPH.

Project Title: Development and Evaluation of an Outcome Measure for Tinnitus

Specific Objective: This study is being conducted to develop and document a new patient questionnaire that can be used for standardized assessment of tinnitus outcomes.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; Oregon Health & Science University, Portland, OR; James A. Haley VAMC, Tampa, FL; VAMC Bay Pines, FL; Cleveland Clinic Foundation, Cleveland, OH; University of Washington, Seattle, WA; Hearing & Speech Institute, Portland, OR.

Participating Investigators: Mary Meikle, PhD; James Henry, PhD; Paula Myers, PhD; William H. Martin, PhD; Craig Newman, PhD; Sharon Sandridge, PhD; Harvey Abrams, PhD; Eric Frederick, AuD.

Project Title: Development of Clinical Instrumentation for Tinnitus Measurement

Specific Objective: This study is developing and testing a computer-automated system to evaluate psychoacoustic components of tinnitus. The objective is to document a system that is appropriate for clinical use.

Agencies and Institutions Involved: Portland VAMC; Bay Pines VAMC; VA Gulf Coast Healthcare System; San Diego VAMC; Oregon Health & Science University.

Participating Investigator: James Henry, PhD; Martin Schechter, PhD; Carl Loovis, PhD; David Miller, PhD; Harvey Abrams, PhD.

Project Title: Effect of Individualized Counseling on Hearing Aid Acceptance

Specific Objectives: This research study seeks to refine the Attitudes to Loss of Hearing Questionnaire (Saunders and Cienkowski, 1996) to improve reliability of certain subscales, to design and test a program for computerized administration of the questionnaire, and to develop a counseling program based upon responses to the ALHQ that aims to change negative attitudes and thus increase hearing aid uptake and use.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; University of Connecticut, Storrs, CT.

Participating Investigators: Gabrielle Saunders, PhD; Kathleen Cienkowski, PhD; Stephen Fausti, PhD.

Project Title: Effect of Training on Central Auditory Function in Multiple Sclerosis

Specific Objectives: The purpose of this rehabilitation research project is to assess thoroughly the central auditory processing (CAP) deficits for patients with MS. Additionally, since there is evidence that the brain is plastic and capable of being retrained (Jancke, Gaab, Wustenberg, et al, 2001), this investigation also will examine whether or not the implementation of an auditory training program can improve central auditory function in patients with MS.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; Oregon Health & Science University, Portland, OR; Center of Excellence on Restoration of Function in Spinal Cord Injury and Multiple Sclerosis, West Haven, CT.

Participating Investigators: Dennis Bourdette, MD; M. Samantha Lewis, PhD; Debbie Wilmington, PhD; Nancy Vaughan, PhD; Stephen Fausti, PhD; Albert Lo, MD, PhD.

Project Title: Impaired Frequency Resolution in Canaries with Hereditary High Frequency Hearing Loss

Specific Objectives: To measure the effects of congenital hearing loss in a non-human species on frequency resolution in order to determine the generality of the effects of hair cell loss on auditory perception. Because of large differences in auditory structure and function between humans and birds, the similarities and differences in these effects will point to aspects of hearing loss that may not be ultimately amenable to intervention in humans, and perhaps some that may.

Agencies and Institutions Involved: University of Maryland, College Park, MD, NCRAR, VAMC Portland, OR.

Participating Investigators: Robert Dooling, PhD; Amanda Lauer, MA; Marjorie Leek, PhD.

Project Title: Improving Health Literacy Using a Tinnitus Education Model

Specific Objective: This proposed study will evaluate different methods for educating people with low health literacy, using tinnitus educational materials.

Agencies and Institutions Involved: NCRAR, VAMC, Portland, OR; James A. Haley VAMC, Tampa, FL; Cleveland Clinic Foundation, Cleveland, OH; University of Arizona, Phoenix, AZ; University of California, San Diego, CA.

Participating Investigators: James Henry, PhD; Paula Myers, PhD; Kenneth James, PhD; Craig Newman, PhD; Sharon Sandridge, PhD.

Project Title: Investigation of Individualized Otoacoustic Emission Techniques for Early Detection of Ototoxicity

Specific Objectives: The objective of this study is to determine the most reliable, sensitive and efficient objective technique for early detection of ototoxicity using otoacoustic emission (OAE) testing, with the goal prevention of ototoxic hearing loss in veterans.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; VAMC Nashville, TN.

Participating Investigators: Stephen Fausti, PhD; Dawn Konrad-Martin, PhD; Gene Bratt, PhD.

Project Title: Lip and Sign Reading with Combined Vision and Hearing Deficits

Specific Objectives: These pilot studies propose to explore the problem of lip and sign reading in visually impaired elders to generate pilot data that will be useful in generating a full proposal to develop innovative scanning strategies and optical-electrical aids for individuals with dual sensory impairment.

Agencies and Institutions Involved: The Smith-Kettlewell Eye Research Institute, San Francisco, CA; NCRAR, VA Medical Center, Portland, OR.

Participating Investigators: John Brabyn, PhD; Stephen Fausti, PhD.

Project Title: Multi-Site Randomized Clinical Study of Tinnitus Treatment Methods

Specific Objectives: This randomized clinical trial is evaluating three different methods of individualized long-term treatment for severe tinnitus.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; Puget Sound VA Health Care System, Seattle-Tacoma, WA; Bay Pines VAMC, Bay Pines, FL; San Diego VAMC, San Diego, CA; Oregon Health & Science University, Portland, OR.

Participating Investigators: James Henry, PhD; Martin Schechter, PhD; Carl Loovis, PhD; Harvey Abrams, PhD; David Miller, PhD.

Project Title: Oregon Cancer Center

Specific Objectives: Disease-specific specialists and scientists from medicine, surgery, radiation therapy, nursing, social work and other areas work together to facilitate the development of individualized diagnosis, treatment, rehabilitation and follow-up for cancer patients.

Agencies and Institutions Involved: Oregon Cancer Institute, Oregon Health & Science University, Portland, OR; NCRAR, VAMC Portland, OR.

Participating Investigators: Grover Bagby, Jr., MD; Stephen Fausti, PhD.

Project Title: Progressive Intervention Program for Tinnitus Management

Specific Objectives: The objective of the proposed study is to establish the model program at a VA audiology clinic, and to evaluate its efficacy with veteran patients and its acceptability to audiologists and to hospital administration.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; James A. Haley VA Medical Center, Tampa, FL; University of Washington, Seattle, WA.

Participating Investigators: James Henry, PhD; Paula Myers, PhD; Ken James, PhD; David Hickam, MD, MPH; Martin Schechter, PhD; Harvey Abrams, PhD; Macia Legro, PhD.

Project Title: Randomized Clinical Study of Group Education for Tinnitus Intervention

Specific Objective: This randomized clinical trial is proposed to evaluate the efficacy of an improved and more efficient group education method for treatment of veterans with tinnitus.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; University of California at San Diego; Cleveland Clinic Foundation.

Participating Investigators: James Henry, PhD; Ken James, PhD.

Project Title: Randomized Clinical Trial to Assess Benefit of Group Therapy for Tinnitus

Specific Objectives: The purpose of this randomized clinical trial study, completed June 2005, was to test the hypothesis that many veterans with less severe tinnitus would receive significant benefit from basic education and counseling, which could be provided in a group format.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; VA Puget Sound Health Care System, Seattle-Tacoma, WA; Jesse Brown VAMC, Chicago, IL; James A. Haley VAMC, Tampa, FL; Central Texas VAMC, Austin, TX.

Participating Investigators: James Henry, PhD; Carl Loovis, PhD; Denis Moore, AuD; Paula Myers, PhD; Judy Abrahamson, PhD.

Project Title: Randomized Trial of a Brief Patient-Centered Aural Rehabilitation Model

Specific Objectives: This clinical trial will explore the efficacy of a brief aural rehabilitation (AR) intervention: The Living Well with Hearing Loss Workshop. The workshop (to be developed) will be a 2 hour interactive session for 4-8 veterans that will address specific hearing related issues presented by the participants themselves as well as teaching problem-solving and emotion-focused coping skills.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; VAMC, Bay Pines, FL.

Participating Investigators: Mitchel Turbin, PhD; Harvey Abrams, PhD.

Project Title: The Effects of Cognitive Processing on Speech Recognition

Specific Objectives: The aim of the study was to determine whether older adults (ages 50 through 75 years) who performed poorly on certain cognitive tasks also performed poorly on cognitively loaded speech recognition tests using time-compressed speech.

Agencies and Institutions Involved: NCRAR, VAMC Portland, OR; Department of Behavioral Neuroscience, Oregon Health & Science University, Portland, OR.

Participating Investigators: Nancy Vaughan, PhD; Jeri Janowsky, PhD.

Project Title: The Effects of Diabetes on Processing of Verbal Communication

Specific Objectives: To investigate the processing of verbal communication in veterans with and without diabetes mellitus through a comprehensive battery of auditory and cognitive tests. The identification of speech processing deficits should lead to the development of appropriate strategies and techniques for rehabilitation to optimize verbal communication in diabetics.

Agencies and Institutions Involved: NCRAR and HSR&D Program, VAMC Portland, OR; Departments of Behavioral Neuroscience, Neurology and Public Health & Preventive Medicine, Diabetes Center, Oregon Health & Science University, Portland, OR.

Participating Investigators: Nancy Vaughan, PhD; Stephen Fausti, PhD; Donald Austin, MD, MPH; David Hickam, MD, MPH; Barry Oken, MD; Andrew Ahmann, MD; Daniel Storzbach, PhD.

Project Title: The Influence of Neural Synchrony on the Compound Action Potential, Masking and the Discrimination of Harmonic Complexes in Several Avian and Mammalian Species

Specific Objectives: To determine the influence of cochlear length and cochlear delay on the auditory physiological function and perception of complex sounds in humans and other species with varying size cochleas.

Agencies and Institutions Involved: University of Maryland, College Park, Maryland; University of Regensburg, Regensburg, Germany.

Participating Investigators: Robert Dooling, PhD; Otto Gleich, PhD; Marjorie Leek, PhD.

Project Title: The Veterans' Hearing Loss Prevention Program: Improving Hearing Health

Specific Objectives: The goal is to create a hearing loss prevention program that can provide high-quality hearing health care to soldiers and veterans. The project objectives are to create a multimedia Hearing Loss Prevention Program that can be delivered in a primary care or other medical setting, to create a seamless continuum of care between the DoD and the VA, and to demonstrate the feasibility of sharing hearing health care records between the DoD and the VA.

Agencies and Institutions Involved: NCRAR, Portland VAMC, Portland, OR; DoD, U.S. Air Force, Brooks City-Base, TX.

Participating Investigators: Gabrielle Saunders, PhD; Marjorie Leek, PhD; Stephen Fausti, PhD; Susan Griest, MPH; Dennis Smith, MD; Dawn Konrad-Martin, PhD; Judy Sobel, PhD; Dale Ostler, PhD; Douglas Ohlin, PhD.

Project Title: Vibration sensitivity and perception thresholds of human vital and nonvital maxillary incisors

Specific Objectives: The objective of this research is to use a psychological approach to understand the role of oral mechanoreceptors in the control of the mandible as their previous results suggest that incisor teeth encode a wide range of vibration frequencies, which contribute to the perception of textures of food bolus' within the oral cavity.

Agencies and Institutions Involved: NCRAR, VAMC, Portland, OR; Department of Dentistry, Oregon Health & Science University, Portland, OR.

Participating Investigators: Lee Robertson, PhD; Jay Levy, DDS; Daniel Petrisor, DDS; David Lilly, PhD.

VIII. SERVICE TO VA AND REHABILITATION PROFESSIONS

The NCRAR encourages its staff to remain active in clinical care within their respective professions and to serve the VA and the rehabilitation community through active participation in clinical presentations, community seminars, support groups, grand rounds and other medical practice forums. NCRAR rehabilitation researchers serve on numerous VA editorial and scientific merit review boards, advisory committees and task forces, as well as a plethora of professional advisory and review committees, editorial review boards, special study sections, and task forces. The following are representative of how the NCRAR staff served the VA and the scientific and rehabilitation professions during 2005:

- Ad hoc Reviewer, *American Journal of Audiology* (M. Samantha Lewis; G. Saunders).
- Ad hoc Reviewer, *Ear and Hearing* (D. Konrad-Martin; G. Saunders).
- Ad hoc Reviewer, *Hearing Research* (D. Trune).
- Ad hoc Reviewer, *International Journal of Audiology* (D. Konrad-Martin; G. Saunders; M. Samantha Lewis).
- Ad hoc Reviewer, *Journal of Neuroscience* (D. Trune).
- Ad hoc Reviewer, *Journal of Rehabilitation Research and Development* (G. Saunders).
- Ad hoc Reviewer, *Journal of the Acoustical Society of America* (D. Konrad-Martin; M. Leek).
- Ad hoc Reviewer, *Journal of the American Academy of Audiology* (M. Samantha Lewis; G. Saunders).
- Ad hoc Reviewer, *Journal of the Association for Research in Otolaryngology* (D. Trune).
- Ad hoc Reviewer, NIH Neuroepidemiology, Aging and Musculoskeletal Epidemiology Study Sections (D. Trune).
- Ad hoc Reviewer, *Volta Review* (D. Trune).
- Assistant Coordinator, Steering Committee for the ASHA Division 6 (D. Konrad-Martin).
- Assistant Editor, *Journal of the American Academy of Audiology* (G. Saunders).
- Chair, NCRAR Investigator Committee (G. Saunders).
- Chair, NCRAR Pre-Conference Workshop ‘Ototoxicity: Early Identification and Monitoring’ (D. Konrad-Martin).
- Chair, NCRAR Space Committee (N. Vaughan).
- Chair, Pre-Convention Workshops (Learning Labs) Subcommittee, 18th Annual American Academy of Audiology (M. Samantha Lewis).
- Chair, School of Medicine, Department of Neurology, OHSU (D. Bourdette).
- Chair, Tinnitus Measurement Session, VIIIth International Tinnitus Seminar, Pau, France (J. Henry).
- Co-Chairs, NCRAR biennial national conference ‘The Aging Auditory System: Considerations for Rehabilitation’ (G. Saunders, C. Landsverk, N. Vaughan).
- Co-Chairs, Program Committee, NCRAR biennial national conference (N. Vaughan, E. Leigh-Paffenroth, J. Jerger, S. Gordon-Salant, T. Wiley).

- Co-Director/Associate Director, U.S. Department of Veterans Affairs MS Center of Excellence-West (D. Bourdette).
- Director, OHSU MS Center of Oregon (D. Bourdette).
- Executive Council, Associate Member Delegate, National Hearing Conservation Association (S. Griest).
- Executive Council, Individual Member Delegate, National Hearing Conservation Association (S. Griest).
- Guest Editors, special issue of the *Journal of Rehabilitation Research and Development* (H. Levitt; S. Fausti; J. Schein).
- Manager, Electron Microscopy Facility, Department of Otolaryngology, OHSU (D. Trune).
- Member, Ad hoc professional committee to establish tinnitus definitions for the Scientific Advisory Committee, American Tinnitus Association (J. Henry).
- Member, Advocacy and Legal Committee, American Tinnitus Association (J. Henry).
- Member, DoD Hearing Conservation Workgroup (S. Fausti).
- Member, Editorial Board of the *Journal of Rehabilitation Research and Development* (S. Fausti).
- Member, International Scientific Committee for the VIIIth International Tinnitus Seminar, Pau, France (J. Henry).
- Member, IRB Committee, Research and Development Service, Portland VAMC (J. Henry).
- Member, Medical Advisory Board of the National Multiple Sclerosis Society (D. Bourdette).
- Members, NCRAR Executive Committee (S. Fausti; D. Smith; D. Phillips; G. Saunders; D. Konrad-Martin; P. Helt; D. McDermott).
- Member, Planning Committee for the Columbia River/Willamette Valley Combined Federal Campaign, Portland VAMC (C. Landsverk).
- Member, Pre-Convention Sub-committee, American Academy of Audiology Convention (J. Henry).
- Member, Promotion & Tenure Committee, Department of Otolaryngology, OHSU (D. Trune).
- Members, Research & Development Committee, Portland VA Medical Center (J. Henry; G. Saunders).
- Member, Research Committee, American Academy of Audiology (M. Samantha Lewis).
- Member, Resident Research Committee, Department of Otolaryngology, OHSU (D. Trune).
- Member, Search Advisory Committee, American Tinnitus Association (J. Henry).
- Member, Task Force on Hearing Conservation in the Public Schools, National Hearing Conservation Association (S. Griest).
- Member, Training Grant Committee, Department of Otolaryngology, OHSU (D. Trune).

- Member, VA Audiology and Speech Pathology Program Office, National Research Board (S. Fausti).
- Member, VACO Field Research Advisory Committee, ORD (S. Fausti).
- Member, Washington County CCI Task Force on Environmental Noise Pollution and its Health Effects on the Citizenry (R. Ellingson).
- Member, Working Group on Effective Interventions for Infants and Young Children with Hearing Loss, Office on Disabilities at the Department of Health and Human Services (S. Fausti).
- Organizer & Moderator, NCRAR/Portland VAMC Clinical Audiology Program Tinnitus Support Group (J. Henry).
- President Elect, Academy of Rehabilitative Audiology (G. Saunders).
- Rheumatology Grand Rounds (D. Trune).
- Rheumatology Journal Club (D. Trune).

IX. IMPACTS/MILESTONES

The NCRAR's multidisciplinary community of clinicians, rehabilitation researchers, and rehabilitation engineers focus their efforts on applied clinical research, auditory rehabilitation, and the development of useful and innovative technologies to address clinical needs that are raised in patient-care environments. This focus has advanced the discovery of new knowledge about hearing impairments, which is directly influencing the field and contributing toward establishing standards of clinical practice while optimizing the aural rehabilitation of veterans with hearing disabilities. The following are representative of clinical impacts and milestones from the NCRAR:

Conference Proceedings Published in Special Issues of Seminars in Hearing: Proceedings from the NCRAR's 2003 biennial international conference entitled, "Aural Rehabilitation: A Multidisciplinary Approach" were published in two separate, special issues of *Seminars in Hearing* (2005;26:2:57-124; and 2005;26:3:125-189). Drs. Gabrielle Saunders and Stephen Fausti served as special guest editors, and both issues were devoted solely to publishing proceedings from the NCRAR conference.

Special Issue of the Journal of Rehabilitation Research & Development: The NCRAR made significant contributions to the production of a special issue of the *Journal of Rehabilitation Research & Development* (2005;42:4:vii-xix:1-198) focused entirely on hearing and hearing loss, with Drs. Harry Levitt, Stephen Fausti, and Jerome Schein serving as guest editors and NCRAR investigators contributing four manuscripts.

Biennial International Conference: The NCRAR hosted its second biennial international conference entitled, "The Aging Auditory System: Considerations for Rehabilitation" on September 22-23, 2005, which was attended by over 200 individuals from 32 states plus New Zealand, Israel, and Canada.

National Ototoxicity Workshop: The NCRAR hosted a national workshop entitled, "Ototoxicity: Early Identification and Monitoring" on September 21, 2005, which was attended by 50 clinical audiologists from across the country.

VA Satellite Broadcast: NCRAR investigator Gabrielle Saunders, PhD, was featured in a live VA Satellite Broadcast on September 8, 2005. The program was titled “Measuring Hearing Aid Outcomes: Not as Easy as it Seems” and featured Dr. Saunders, Dr. Harvey Abrams, Chief, Audiology and Speech Pathology Service, VA Medical Center, Bay Pines, Florida, and Dr. Therese Hnath-Chisolm, Department of Communication Sciences & Disorders, University of South Florida, Tampa, Florida. With a target audience of audiology staff and healthcare technicians in audiology clinics, the satellite broadcast was filmed at the St. Louis VA Employee Education Resource Center and made available nationwide via the VA Employee Education System Network. The presentation aimed at identifying the issues that complicate measurement of hearing aid outcomes, and assisting clinicians in selection of appropriate tools to measure outcome of audiologic treatment as part of a best practice approach to audiologic care.

Information Television Network: NCRAR investigator James Henry, PhD, was interviewed by the Information Television Network to create a special documentary on tinnitus. The interview was part of a series of health documentaries titled “Healthy Body, Healthy Mind”, produced by the Public Broadcasting System (PBS). Dr. Henry was interviewed June 1, 2005 at NCRAR, discussing the condition of tinnitus, its impact on daily life, and options for treatment. The interview featured a veteran being tested with the NCRAR’s innovative, prototype computerized tinnitus-evaluation system. The series was to air on PBS late in 2005.

Evidence-based Ototoxicity Early Identification and Monitoring Protocol: NCRAR rehabilitation researchers and engineers have developed an evidence-based protocol for early identification and monitoring of ototoxic hearing change using proven behavioral methods and emerging objective methods. Our behavioral method has been shown to be time efficient (i.e., a time savings of two-thirds of what it takes using conventional methods), sensitive and reliable. This year our protocol has been accepted for publication in a book chapter on pharmacology for Audiology AuD students. We believe this is the first book of its kind, and as such, it should enjoy wide readership among audiology students. Our protocol also has been accepted for publication in the *Volta Review* (2005;105:3;229-250), a preeminent scholarly research and scientific journal in the field of hearing loss, and as the ‘Clinical Feature’ in the American Speech-Language-Hearing Association (ASHA) publication the *ASHA Leader* (2005;10:7:11-14). Portions of the ototoxicity monitoring protocol were presented at three recent clinical conferences, at the Annual Conferences of the American Auditory Society and the American Speech-Language-Hearing Association, and at the 2005 NCRAR Pre-Conference workshop.

Clinical Pamphlets Published by American Speech-Language-Hearing Association:

- NCRAR investigators Dawn Konrad-Martin, PhD, Debbie Wilmington, PhD, and Stephen Fausti, PhD; and research audiologists Jane Gordon, MS, Kelly Reavis, MS, MPH Candidate, and Wendy Helt, MA produced the clinical pamphlet, “Audiological Monitoring of Patients Receiving Ototoxic Drugs”, which was published and distributed by the *ASHA Special Interest Division 6, Hearing and Hearing Disorders: Research and Diagnostics*. 2005;9:17-21.
- NCRAR investigators Elizabeth Leigh-Paffenroth, PhD, Stephen Fausti, PhD, and Dawn Konrad-Martin; and research audiologists Kelly Reavis, MA, Jane Gordon, MS, and Kathleen Dunkley, MA, PhD Candidate, produced the clinical pamphlet, “Objective Measures of Ototoxicity”, which was published for distribution by the *ASHA Special Interest Division 6, Hearing and Hearing Disorders: Research and Diagnostics*. 2005;9:10-16.

- NCRAR investigators M. Samantha Lewis, PhD, and Gabrielle Saunders, PhD, produced the clinical pamphlet, “Tips for improving your listening experience”, which was published for distribution by the *American Speech-Language-Hearing Association*.
- NCRAR investigator Nancy Vaughan, PhD, produced the clinical pamphlet, “Why can’t I understand speech?”, which was published for distribution by, the *American Speech-Language-Hearing Association*.

Hearing Health Article Published: NCRAR investigators Nancy Vaughan, PhD, and Donald Austin, MD, MPH, produced the article, “Greater Hearing Loss in Young Diabetics”, which was published in *Hearing Health*, 2005;30-33.

Rehabilitation Tools (Devices and Techniques) Developed:

- NCRAR rehabilitation researchers and engineers continue to lead efforts to quantify the acoustical aspects of tinnitus, and have developed a patient-interactive, computer automated tinnitus psychoacoustic testing system that measures tinnitus loudness and pitch reliably and in a standardized format (Invention Disclosure submitted December 2005). Clinical trials to validate the clinical efficacy of this prototype instrumentation are currently underway. This research also is likely to result in the establishment of best practices for tinnitus measurement, which is necessary to make tinnitus evaluation and treatment a standard level of health care throughout the VA health care system and the nation.
- NCRAR investigators are addressing rehabilitation solution for tinnitus. They are leaders in the use of Tinnitus Retraining Therapy (TRT), which their research has demonstrated provides relief to sufferers of clinically-significant tinnitus. Members of the NCRAR are preparing a text that will provide clinical guidelines for conducting Tinnitus Retraining Therapy (TRT). In addition, these NCRAR members, in conjunction with the PVAMC Audiology Clinic, lead monthly tinnitus support group for veterans. This program has been a highly successful and popular clinical outreach service.
- NCRAR rehabilitation researchers are in the process of completing the development of the Attitudes to Loss of Hearing Questionnaire (ALHQ) and associated modular counseling package. It is anticipated that the ALHQ will be utilized in Audiology Clinics throughout the VA health care system and the nation once its effectiveness has been evaluated and confirmed. It will provide clinicians with an efficient and effective process for evaluating and counseling their patients prior to fitting hearing aids.
- NCRAR rehabilitation researchers developed the Performance-Perceptual Test (PPT), which will have clinical utility for testing actual versus perceived speech perception in noise, and for counseling individuals that substantially either underestimate or overestimate their hearing ability. Data collected with the PPT suggests that under-estimation of hearing ability is associated with more reported auditory handicap than expected and less satisfaction with hearing aids. Conversely, overestimation of hearing ability may be associated with ‘denial’ and a lack of motivation to acquire hearing aids.
- NCRAR rehabilitation researchers have developed several experimental evidence-based protocols for early identification and monitoring of ototoxic hearing change using emerging objective methods.

X. SUMMARY

The NCRAR located at the VAMC Portland, Oregon was established on October 1, 1997, and has evolved a productive multidisciplinary national Center of Excellence focused on rehabilitative auditory research and development. The NCRAR has established its core infrastructure that provides maximal administrative efficiencies, control and reporting capabilities, dedicated facilities, and shared equipment and instrumentation, and research support personnel. This core infrastructure has supported and cultivated the development of a community of VA clinical scientists, scholars and collaborators who have been successful in competing for scientifically peer-reviewed funding, conducting auditory research and development activities that target important rehabilitation needs for veterans, and fostering the translation of evidence-based research devices and techniques into clinical practice through scientific and professional publications and presentations, and community education programs.

The NCRAR has been extraordinarily successful in building greater VA rehabilitation research capacity in the focus area of auditory research and development, and in advancing VA rehabilitation research and development achievements in the scientific and national consciousness. NCRAR investigators are experienced professionals with outstanding reputations and excellent records of obtaining extramural funding. The NCRAR will continue to build on this very successful model to further itself as the national leader in rehabilitative auditory research and development, and as a national resource for hearing impaired veterans, the rehabilitation community at large, and health care and service professionals.